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Color in Television Studio Lighting

By ROLLO GILLESPIE WILLIAMS

Color lighting in TV studios is discussed as a means of producing accurate color rendition in the TV picture. The spectral distribution of light in relation to vision, color perception and picture color rendition is considered. The unsuitability of degrees Kelvin as a guide to spectral quality is proposed. The importance of simultaneous contrast in relation to color perception is emphasized, and the use of contrast in connection with background and surround lighting is discussed. Methods of producing and blending colored light are reviewed and suggestions made concerning filters and color-mixing systems.

Every color can be varied in appearance. The physical stimulus of spectral energy initiates color vision, but physiological and psychological factors also influence the perception of color. This paper considers some of the facts determining color perception and discusses methods of using different spectral energy distributions of light as a means of influencing color appearances.

The word "color" has a wide range of meanings and in one sense can be used to define different spectral energy distributions of light regardless of the degree to which they seem to depart from a pure white light. However, the word "color" suggests to many people something with a pronounced hue, and the term "color lighting" therefore may imply vivid hues of the kind employed for theatrical effects. In the sense that these terms are employed in this paper, "color" and "color lighting" concern any spectral distributions that combine to produce light that departs in appearance from pure white of the same brightness.

Color Perception

The human eye does not directly perceive external objects, but is responsive to patterns of spectral energy focussed on to the retina of the eye. The many physiological and psychological factors that are involved before the spectral energy is translated by the eye and brain into perceptible images include eye adaptation, simultaneous and successive contrasts, after-images, eye fatigue and certain psychological factors such, as "observer interpretation." Physicists are still searching for a completely adequate theory to explain the human perception of color. It is known, however, that nearly every color can be matched by mixtures of three basic or "primary" colors, and the trichromatic theory is therefore a very useful one. It is assumed that the cone mechanisms in the eye are of three types, each having a different spectral sensitivity. These three types of cones provide sensations of "red," "green" and "blue." Experiments concerning the actual visual responses of the three mechanisms of cone vision continue, but it is apparent that each type responds in some degree to most of the wavelengths in the visible spectrum with maximum sensitivity assumed to be near 600 mμ (red), 540 mμ (green) and 445 mμ (blue) (Fig. 1 gives curves by W. S. Stiles which show the red to have maximum sensitivity at about 580 mμ).

Color perception is related to the relative and simultaneous responses of the three cone mechanisms, and in normal human vision the color reflectance values of external objects are determined to a large extent by the spectral energy distribution of the illuminant. Thus, color rendition varies considerably with fluorescent lamps of different color qualities and with daylight and incandescent lighting. For example, complexions are flattered and the red element in colors emphasized with the Deluxe Warm White fluorescent lamp, whereas the Standard Warm White lamp sometimes makes complexions appear sallow, while deep reds are somewhat dulled.

Presented on October 3, 1955, at the Society's Convention at Lake Placid, N.Y., by Rollo Gillespie Williams, Century Lighting Inc., 521 W. 43 St., New York 36.
(This paper was received on September 8, 1955.)

Color Temperature

In this connection an interesting point arises, inasmuch as the light from both Deluxe and Standard Warm White lamps appears to the eye to be almost identical, whereas their spectral energy distributions are quite different. These two lamps are also plotted on the same point in the CIE chromaticity diagram near to the blackbody (Planckian) locus representing the color temperature curve (K°). Thus, the specification of both Deluxe and Standard Warm White lamps by color temperature would be misleading, inasmuch as both would receive the same rating and no information would be provided concerning their different spectral energy distributions. The use of Kelvin values to classify fluorescent lamps has now been discontinued, but the example just quoted shows that color temperature ratings concern the chromaticity of the light but not its spectral distribution (Fig. 2).

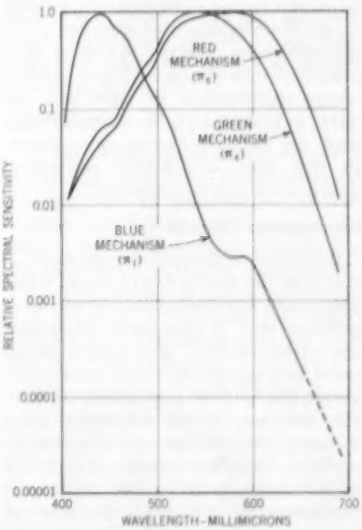

Fig. 1. Relative spectral sensitivities of the main mechanisms of cone vision (W. S. Stiles in *Illuminating Engineering*, Feb. 1954)

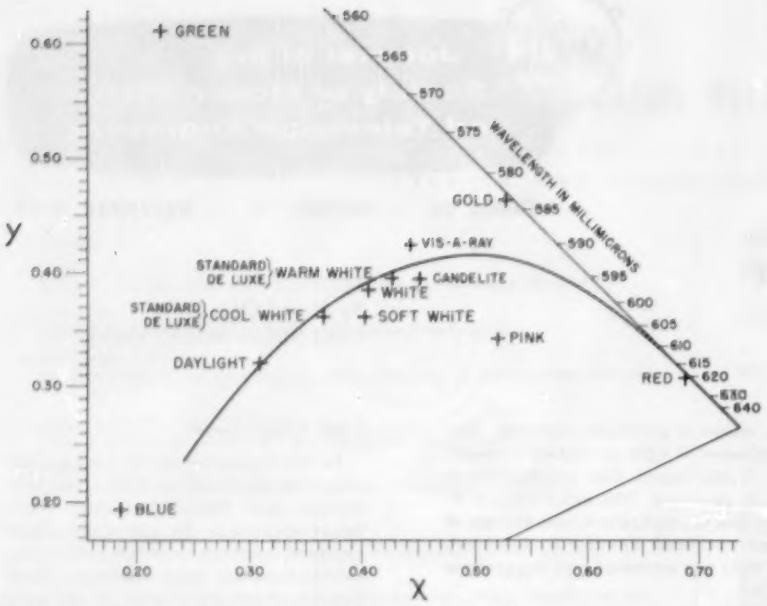

Fig. 2. The location of a number of white and colored fluorescent lamps in the CIE chromaticity diagram showing that Standard and De Luxe warm white lamps are plotted on the same point (*IES Lighting Handbook*).

It has been practical to classify incandescent lamps by Kelvin ratings because the spectral energy distributions of lamps in the color temperature range favored by TV and motion-picture studios vary little from each other, and Kelvin ratings therefore provide a convenient method of classification. It should be borne in mind, however, that this method is a matter of convenience rather than scientific analysis, because as has been shown, two illuminants may exactly match in appearance and in Kelvin rating but possess quite different spectral energy distributions and therefore quite different color rendition qualities. It is possible that for studio work new spectral energy distributions of light will become available and be more suitable than the present incandescent lamps. In this case, a different method of classification may be necessary.

Simultaneous Contrast

Important as spectral energy distribution is to the perception of color, it has been found that background or surround contrasts may be even more important. The apparent color of a surface illuminated in a specific manner can be completely changed in appearance by suitable contrasts in the brightness, color and area of the background or surrounding field. Thus, the orange-red glow of a lighted cigarette tip can be changed to blue-green by suitable environmental lighting or a spectral hue changed in appearance by being viewed through a brightly lighted surround of a contrasting (but not complementary) color.

A color is usually independent of its surrounding field if it is at least ten times brighter, but when it is of a near brightness, its appearance can be considerably influenced by surround color. When the brightness of the surround is considerably greater than the subject color, the latter will tend to take on the complementary hue of the former.

Phenomena associated with eye adaptation may be more marked when dealing with luminous colors than with pigments, and in the case of TV color receivers a luminous picture, rather than reflected light from external objects is viewed. This contributes to the variance in color perceptions often experienced when viewing the televised color picture compared to direct perception in the studio. Furthermore, the state of eye adaptation is almost certain to be different in both cases since the observer of the TV screen is viewing a luminous picture within a narrow angle of vision, whereas in the studio the range of vision would include a number of surface and color brightnesses external to the portion of the scene taken in by the TV camera. Since the visual mechanism of the eye functions as an averaging device so that the sense of color and brightness is related to the mean average of all reflectances and luminances within the field of vision, an observer in the studio is likely to have a different sense of color values compared to those which would be seen by him on the fluorescent screen of the picture tube.

Background Color Lighting

Because of the intricacies of visual phenomena it is difficult to predict exactly the appearance of any color that is to be viewed as part of a color grouping. Thus the color appearance of a sponsor's product may be unsatisfactory on color TV, although the studio lighting and color camera are balanced to give accurate color rendition. The desired color rendition of the product can be obtained in many cases by adjustment of the color values of the background or surround against which it is seen. Since background or surround color appearance is initiated by the spectral energy distribution of the light reflected by each, the desired changes can be effected either by (a) changes of the color of the incident lighting or (b) by using white or gray surfaces illuminated by colored light. Thus, by using colored light, adjustments can be made to the whole or any part of the setting. In the case of (a), color reflectance adjustments can be made by use of filters on the lights, but subtle changes can also be made by modifiable white light, as for example, when lighting units incorporate a primary source of white light with three secondary sources of colored light (e.g. red, green and blue)—the four sources being arranged to blend and used in conjunction with controls which regulate the quantity of light from the three secondary sources in relation to the primary source.

Dramatic Effects

Color lighting can also be used for dramatic effects, delineation of form, pictorial compositions of luminous color, effects of nature and the creation of mood. It can be either static or mobile and can add dynamic effect to the picture. In an address before the NARTB Engineering Conference in Chicago, May 1954, Reid R. Davis stated, "The use of colored lights in this medium is by far the greatest artistic advance we have made in the lighting field."

Production of Colored Light

Different colors of light can be provided either by fitting filters onto standard lighting units or by blending the light from three- or four-color lighting equipment. In the case of filters the color range is limited to available color filters, and this is restrictive in the sense that there are numerous tints for which filters are not available. Additive color blending from a multicolor system employing red, green and blue primaries will, however, allow almost any desired color to be produced. Furthermore, colors can be changed in front of the camera while the show is on the air. The advantages of additive color mixing are generally recognized, but a larger electrical load is required than with standard fixtures fitted with color filters to choice; and, when large areas are to be lighted, this is sometimes a drawback. Thus, additive color blending from multicolor equipment in its present form

is particularly suitable for small background or surround areas and for accent or local lighting.

Primary Colors

Red, green and blue "primaries" are usually employed in three-color lighting equipment. If the wavelength bands of each "primary" are suitably related, it is possible to obtain practically any known color of light by mixture. It is believed by some that there are absolute values for each primary, but this is not the case; and, within certain limits, there is considerable choice as to the exact wavelength bands that can be employed. The author has had very successful results with wavelength bands of 600–720 mμ for the red, 490–550 mμ for the green and 430–470 mμ for the blue. In each case, the maximum intensity would be near the middle of each wavelength band.

When one considers the spectral qualities of the primary colors, it is helpful to remember: (a) that better color mixing will result from narrow wavelength band primaries but the resultant lighting intensity will not be as high as with primaries having wider spectral distributions, and (b) also that a mixture of the primary colors cannot have greater saturation than the primary colors themselves. In the case of the blue primary, it is important that a pure blue rather than a violet hue be employed, else it will be impossible to produce pure blue from the system, whereas the violet can always be obtained by adding a little red light to the blue.

Three-Color White

The three primaries should be able to produce white light without difficulty, although with incandescent lamps and standard filters it may be necessary to regulate the relative intensities to produce this result. If a pure white can be obtained from red, green and blue primaries, then it is possible to produce almost any known tint or pastel color from the system (Fig. 3). Generally speaking, three-color "white" brings out the hue of colors better than ordinary incandescent lighting, and the addition of three-color white to ordinary white light makes an excellent combination.

Four-Color Lighting

Slight changes in the make-up of the three-color white that are unnoticeable in combination with the white light will produce marked effects on the color appearance of objects seen under the combined illumination. After many years' experience with three-color lighting, the author found that four-color lighting of the type indicated (three colors and white) was a great improvement. One important advantage is that it enables white, near-white and pastel

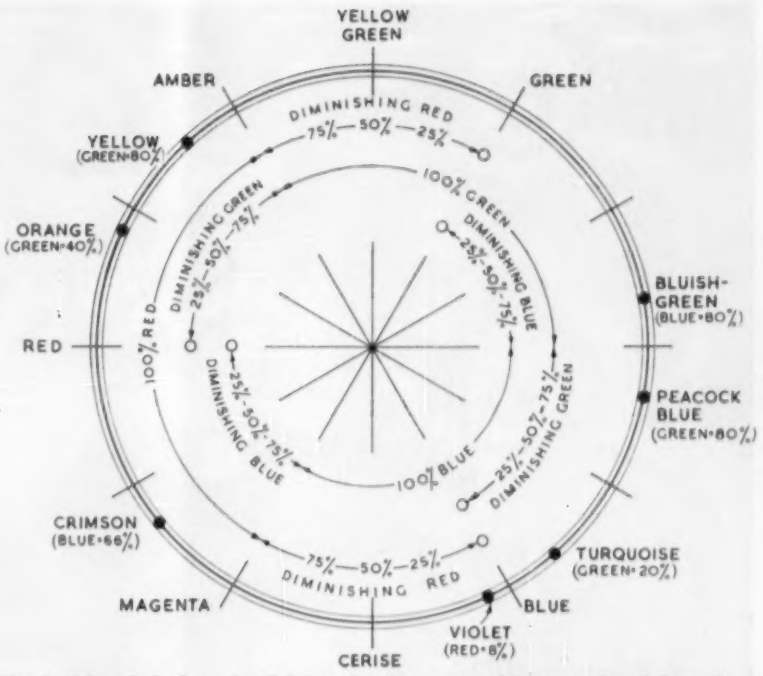

Fig. 3. Color circle for color lighting showing range of hues produced from three primary colors, red, green and blue, of specified spectral energy distribution — blended in the proportions shown. Complementary colors are at opposite ends of a straight line through the center point (*Lighting for Color and Form* **by Rollo Gillespie Williams, Pitman Publishing Corp., 1954**).

colors to be obtained at much higher lighting intensities than would be possible with three-color lighting. When simple white light is required, only a single circuit need be used, and when deep colors are necessary, the three primary colors are available for this purpose.

One of the practical difficulties with three- and four-color lighting is that standard equipment is usually available only for strip, or flood-lighting effects, and spotlighting effects then have to be obtained from a number of separate spotlights with overlapping beams. This tends to result in color shadows. However, it is possible to produce spotlight equipment which combines the primary colors into a single beam of light, and when this type of equipment comes into general use, it will greatly facilitate the development of color change lighting.

Intensity Control

Problems sometimes arise when the over-all intensity of a blend of light produced from a multicolor system has to be varied because reduction of the line voltage to the same extent for all "primaries" will disproportionately affect their relative values if they are not all initially at the same strength. Thus a pale pink light comprised of 100% blue, 25% white and 10% red will completely change in appearance if the voltage is lowered. Care must be taken to regulate the voltages of each primary circuit so that the proportion of the lighting values remains unchanged (Figs. 4 and 5).

Sometimes, red, green and blue are not the most satisfactory colors to employ for a mixing system, and when light output is of first importance and there is little need for saturated colors, the use of magenta, yellow and peacock blue filters may be better. Occasions even arise when pastel colors are adequate, and in these cases, the use of pale pink, light blue and gold filters will provide excellent results.

Conclusion

Studio lighting must enable the actors and setting to be seen by the television audience, but its functions do not end here since the lighting itself has suggestive power and by itself can constitute a beautiful and balanced composition. The author would like to conclude this brief paper with the following extract from his book, *Lighting for Color and Form* (Pitman Publishing Corp.):

"Vast possibilities exist for the use of colored light as a basic and variable element of design, and also as a means of intensifying emotional values by subtle changing of the colors of the modeling lights in front of the color camera. New conventions and techniques are due to arise that will develop these potentialities, and they will open the way for many important new ideas and treatments."

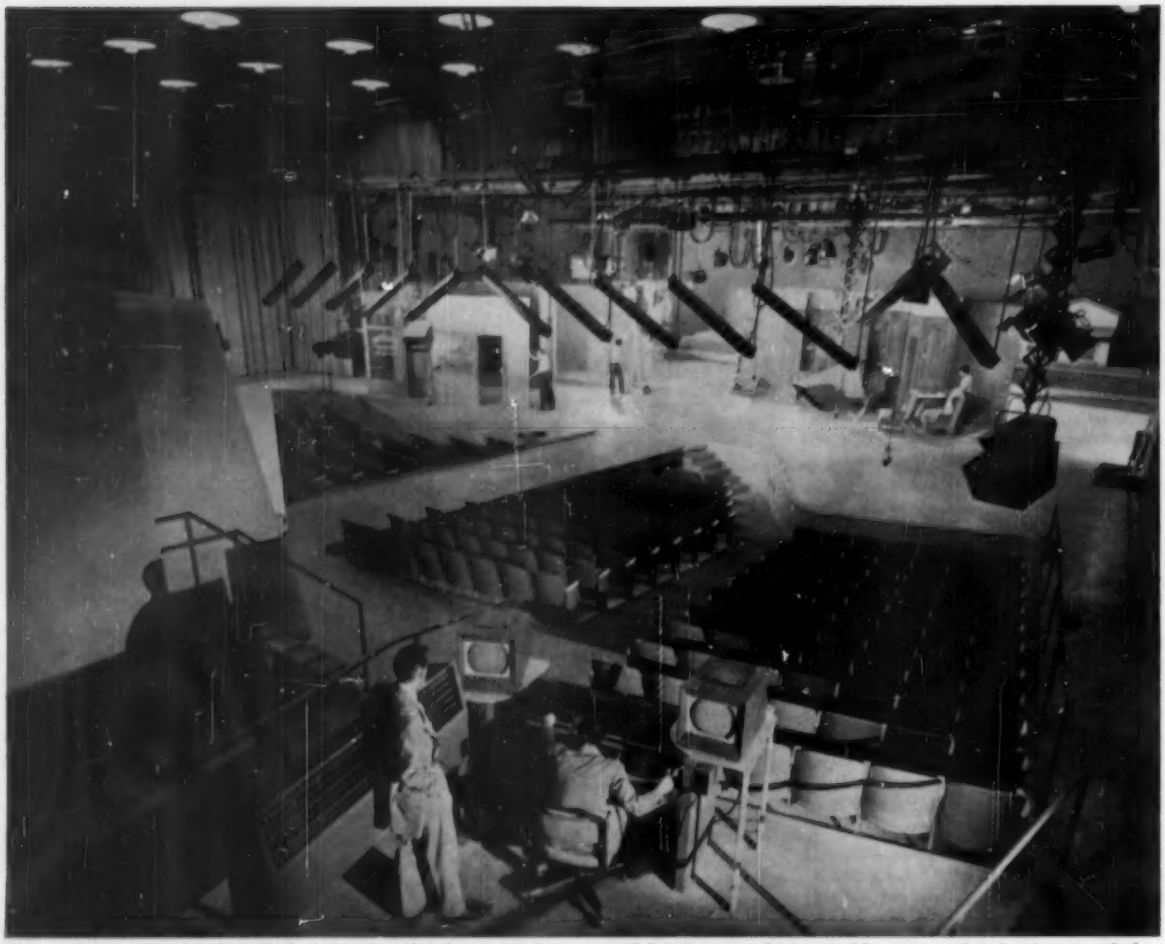

Fig. 4. Color television installation showing lighting control console of C-I System which provides proportional voltage variation when dimming and cross-fading a number of dimmers (Century Lighting, Inc.).

Discussion

David B. Joy (*National Carbon Co.*): Did you conclude from this work what would be the ideal color of light sources for color television?

Mr. Williams: I would think that modifiable light obtained from lighting units combining incandescent white light with light from red, green and blue primary colored lights would be best. You could then obtain a mixture ranging from any of the spectral hues and magenta colors (which of course aren't in the spectrum) and through a very large range of whites of different spectral quality. This would include numerous whites that we know nothing about, which might at times be more suitable than those we do know about.

Fig. 5. Remotely located thyratron-type dimmer bank of type used in C-I System shown in Fig. 4 (Century Lighting, Inc.).

Mr. Joy: Could that be interpreted in color temperature?

Mr. Williams: Color temperature ratings, as far as I'm concerned, are out because they only deal with the appearance of light when matched with the light from a blackbody. They don't give us any information about special energy distribution which is what concerns us in TV photography.

Mr. Joy: Is the light toward the blue white, or the yellow white?

Mr. Williams: It would be anything you'd like to make it according to the proportion of white, green and red and blue blended in the mix.

C. J. Staud (*Eastman Kodak Co.*): Many people in the field get unhappy with anyone talking about color temperatures of other than blackbodies. I assume it's widely known that you can't really speak of color temperature except from blackbody radiation. It seems to me that it causes much confusion to refer to a fluorescent lamp as 3200° or 3400° Kelvin. You can't do it because of the difference in spectral emission. The other point concerns the spectrum of your primaries and I wonder what the advantage was in not having the overlapping primaries which are much more frequently employed.

Mr. Williams: The first remark I completely agree with. I think color temperature ratings should be kept strictly to blackbody temperatures and the appearance of light related thereto, and should be dropped from the language of the TV and motion-picture studio. That they happen to work out at present is really accidental. It's simply that they're using light sources of much the same type, that is, incandescent lamps, and the variations of spectral energy distribution between different sized lamps and for ratings between 2800° and 3200° Kelvin are not very marked. When comparing light from arc lamps with incandescent lamps or fluorescent or daylight, you're in trouble if you use that method of classification.

In answer to your second question, the wider you make the wavelength bands of the primaries the more desaturated is the color range, but the higher the lighting intensity. Ideally, for color purity, the three primaries should be single wavelengths. You can always produce the in-between hues by blending two of these wavelengths in suitable proportions, because two wavelengths or wavelength bands will tend to produce the appearance of an in-between wavelength to the eye. As you widen the wavelength band you desaturate the resultant color. You have to compromise and reach a point where considerations of color purity and lighting efficiency are balanced.

A 225-Ampere Motion-Picture Studio Carbon for Use With 3200–3400 K Color Film

By F. P. HOLLOWAY, C. A. PLASKETT, R. B. DULL and C. W. HANDLEY

A 16mm Super High-Intensity Color-Modified Studio Carbon, designed for use with 3200–3400 K color film, has been developed for set lighting and process projection in motion-picture studios. No filters are needed when a set is illuminated entirely by the color-modified carbon, as proper balance can be obtained during film processing. Only a light filter is required to absorb a small amount of blue and an excess of near ultraviolet radiation to permit the use of mixed incandescent and arc light on motion-picture sets. No filtering is needed for process projection when a relay-condenser-type optical system is employed.

The color-modified carbon in the Brute lamp produces 60% more usable light than the unmodified carbon in the same lamp for use with 3200–3400 K color film, and twice as much usable light as any other motion-picture studio light source.

THE INTRODUCTION of color photography into the motion-picture industry placed greater demands upon light sources for motion-picture studios than did black-and-white photography.[1]

The photographic speed of black-and-white film was such that the over-all light-intensity requirements were very low by comparison to color, and the reproduction variances in the gray scale which resulted when carbon arc light and tungsten sources were mixed were not considered serious.[2] Early color film demanded that the spectral energy distribution of the light source approximate that of sunlight, in addition to a higher over-all level of illumination. Light sources differing in quality from that of sunlight were usable only with suitable filters which absorbed a large portion of the light. The carbon arc, which was the only light source closely approximating sunlight, was, therefore, well suited for color photography.

A color film balanced to 3200–3400 K was recently introduced for tungsten sources, and inasmuch as it was faster than the daylight film suitably filtered for tungsten and when filtered for sunlight was equally as fast as daylight film to sunlight, professional color motion-picture film was changed to the 3200–3400 K balance.[3] It then became necessary to use suitable filters with the high-intensity carbon arc to produce the desired quality of light. These filters reduced the over-all useful light output of the carbon arc by about 40%.

Color with the early tungsten-balanced color film was being shot with key-lighting levels as low as 200 ft-c. However, the use of this low illumination did not last long as technological changes in the motion-picture industry soon created a demand for much higher set-lighting levels. The demands for increased depth of focus and other requirements of new wide-film processes brought key-lighting up to 1,000 ft-c. or higher in some instances.[4]

To meet the latest demands for more light, and to provide sources with sufficient control, power and penetrating ability to overcome base-light levels of set illumination in order to create contrast perspective effects, a new 16mm High-Intensity Super Studio-type positive carbon operating at 225 amp has been developed for use with 3200–3400 K color film. The color of the light from the new carbon has been modified from that of the conventional daylight high-intensity carbon arc without sacrifice in the amount of unfiltered light, to a point where it can be used with the 3200–3400 K color film with only slight filtering, and in some cases without any filtering.

Presented on October 3, 1955, at the Society's Convention at Lake Placid, N.Y., by F. P. Holloway C. A. Plaskett and R. B. Dull (who read the paper), National Carbon Co., Fostoria, Ohio, and by C. W. Handley, National Carbon Co., 2770 Leonis St., Los Angeles 47, Calif.
(This paper was received on October 6, 1955.)

Color Temperature

Light produced by the color-modified carbon has its origin in both the positive crater and the positive tail flame. The color temperature of the light from the crater of the color-modified carbon is 4100 K, while that of the tail flame is somewhat lower. When used in conjunction with a 24-in. Fresnel lens, in the Mole-Richardson Brute lamp for example, light from a portion of the tail flame, as well as crater light, is utilized. The color temperature of light produced by such a lamp depends upon how large a portion of the tail flame is used. At minimum spot, where only a small portion of the tail flame is utilized, the light has a color temperature of 3800 K, while at full flood, where a larger portion of the tail flame is utilized, it is 2900 K.

Color film balanced to 3200–3400 K has sufficient tolerance that a motion-picture set can be illuminated 100 per cent with the color-modified carbon without filtering. Proper color balance can be obtained during laboratory processing of the film. With very slight filtering to reduce the blue and the small amount of ultraviolet which is shown on the spectral energy distribution curve in Fig. 1, excellent balance can be obtained, and light from the color-modified carbon arc can be mixed with that of an incandescent source with no visual difference in the results.

The 225-amp color-modified carbon is adaptable to process projection as well as to set lighting. The color temperature

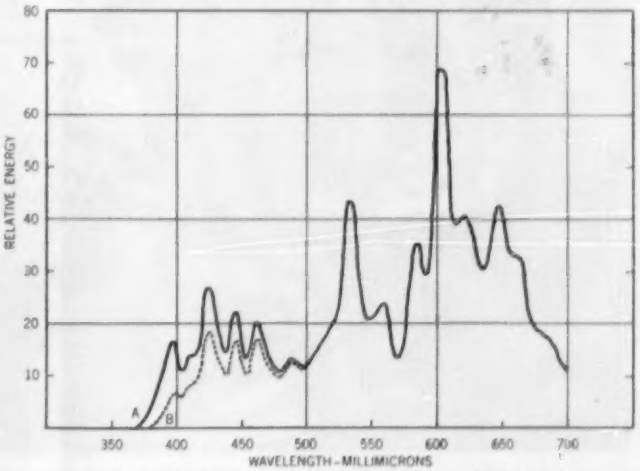

Fig. 1. Spectral energy distribution of color-modified carbon: (A) without filter (B) with filter.

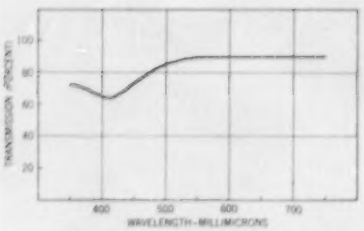

Fig. 2. Spectral transmission of Y-1 filter

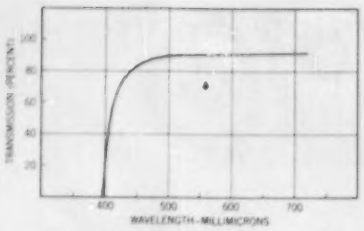

Fig. 3. Spectral transmission of 2-B filter

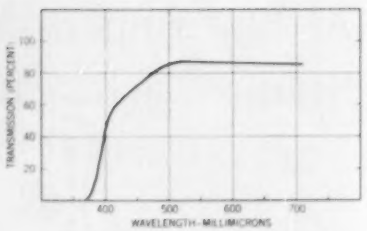

Fig. 4. Spectral transmission of Y-1 filter sprayed with 2-B lacquer

of the projected light depends upon the optical system. With the straight-condenser-type optical system, where most of the light comes from the carbon crater itself, the color temperature is approximately 4000 K, and filtering is required to obtain the proper color balance. With the relay-condenser-type optical system, where some of the tail flame is included in the focused plane, no filtering has been required although there are probably some filtering effects from the translucent process projection screens in general use.

All color temperatures reported were determined from CIE trichromatic coefficients, obtained from spectral energy distribution curves of the radiation.

Filters for the Color-Modified Carbon

It is the general conclusion, based upon film tests supervised by the Motion Picture Research Council, that a Y-1, 2-B filter combination produces adequate color balance to permit the mixing of light from the color-modified carbon with that of an incandescent tungsten source. This combination more nearly coincides with the spectral sensitivity of color film balanced to 3200–3400 K than does the daylight-type high-intensity carbon arc with its Y-1, MT-2 filter combination.

Figure 2 shows the spectral transmission of a Y-1 filter. Only slight filtering takes place in the visible portion of the spectrum. The Y-1 filter removes a portion of the excess near ultraviolet radiation characteristic of carbon arcs. The 2-B filter, the spectral transmission of which is shown in Fig. 3, completes the removal of the excess ultraviolet.

The Y-1 filter material is available in sheets of gelatin which may be mounted in front of the Fresnel lens of the carbon arc lamp. At this date the effect of the 2-B filter may be obtained by two possible methods, i.e., over the camera lens, or included in a lacquer spray which may be coated on the Y-1 filter at the lamp. Figure 4 shows the spectral transmission of a typical Y-1 filter sprayed with a 2-B lacquer. Curve B in Fig. 1 was obtained with the use of this filter.

At the present time some studios are using the Y-1 sprayed with 2-B treatment; some use the standard Y-1 with the 2-B filter in the camera; and at least one studio is using the Y-1 without the addition of the 2-B filter.

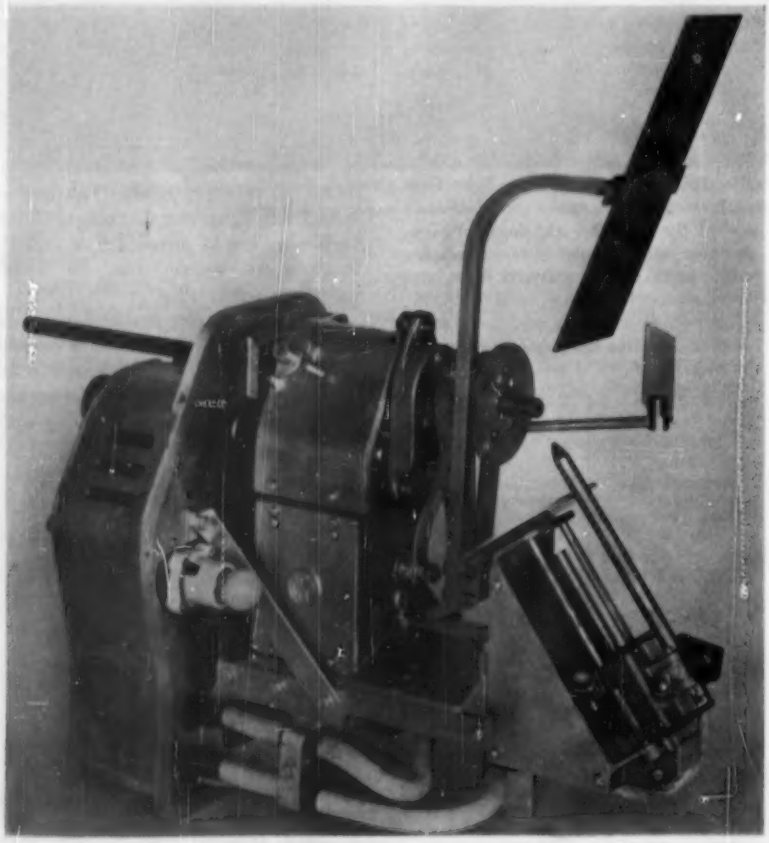

Fig. 5. Arc element and control mechanism subassembly for Mole-Richardson type 450 "Brute" Super High Intensity Arc Spot Lamp

Tail Flame

The tail flame produced by the color-modified carbon is longer than that of the 225-amp daylight high-intensity carbon. As a result of its length there is considerable wavering of the upper portion of the flame which produces an apparent variation in illumination on the motion-picture set. Although light from this portion of the tail flame reaches the set, in most instances, in an area which is out of the photographed zone and is of a very low level of intensity, it has resulted in objections from operating personnel. The Mole-Richardson Co. has developed a flame shield which prevents light from the unstable portion of the tail flame from reaching the motion-picture set. The flame shield is located in such a position that it has very little effect upon photographic light intensity or color temperature. Figure 5 shows the Brute lamp mechanism with flame shield.

Usable Light

The unfiltered 225-amp color-modified carbon produced approximately the same quantity of light as the daylight carbon at the same current. In the Brute lamps and with a Y-1, 2-B filter combination, it produces twice as much usable light as the 10-kw incandescent lamp,[4] and 60% more usable light than the daylight carbon arc with its Y-1, MT-2 filter combination.

Acknowledgments

The authors are indebted to the Motion Picture Research Council for arranging and supervising the film tests conducted with the color-modified carbon and to Mole-Richardson Co. for the many tests they have conducted in their Brute lamps.

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2. R. G. Linderman, C. W. Handley and A. Rodgers, "Illumination in motion picture production," *Jour. SMPE, 40:* 333–367, June 1943.
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4. Petro Vlahos, Committee Chairman, "Motion-picture studio lighting and process photography report," *Jour. SMPTE, 64:* 447, Aug. 1955.

Discussion

Gordon A. Chambers (*Eastman Kodak Co.*): Are you planning to supply similar carbons in smaller sizes as for Duarcs? I understand from the paper that at the present time it's only available for the Brute.

Mr. Dull: That is correct. Whether or not it will be supplied for the Duarc we don't know yet, but it will be investigated and developed for smaller sized carbons.

Thomas T. Goldsmith (*Du Mont Laboratories*): What is the possible running time for color television studio use? How long can you run these arcs continuously for programming?

Mr. Dull: Of course everything depends on the size of carbon, and the current. As I say we have experience only with the 225-amp carbon. My guess is it would be about 20 or 30 minutes.

Peter Mole (*Mole-Richardson Co.*): As to the time of burning, the present lamp will burn continuously for 45 minutes without a re-trim; however, should a lamp of that kind be valuable in color televising, it can be made for longer burning.

Mr. Goldsmith: You mean by lamp design?

Mr. Mole: I would say by increasing the length of carbon. The lamp has no limit in the travel of its feeding mechanism.

George T. Howard (*General Electric Co.*): I believe you said this new carbon produces twice the light of a 10 kw. Does it do this at 275% of the power of the 10 kw?

Mr. Dull: Yes, including power losses in the ballast.

Letters to the Editor

Additional Notes on "History of Sound Motion Pictures"

After reading Dr. Edward W. Kellogg's three-part history in the June, July and August 1955 *Journals* with considerable interest, I would like to add some notes on early developments in sound film recording in England.

The first British film producer to achieve any success with talking pictures was the late Cecil M. Hepworth, who made a large number of synchronized disc shorts in his Walton-on-Thames studio between 1906 and 1913, under the trade name "Hepworth Vivaphone." The discs were made first at a regular gramophone recording studio, and then played back on the studio stage with a gramophone mechanically coupled to a motion-picture camera. Mr. Hepworth supplied exhibitors with a simple and effective electrical synchronizing device for projectors and acoustic gramophone reproducers. This system gave the projectionist a red or green light indication whether he was turning the handle of the projector too fast or too slow for the sound of the gramophone, which was placed below the screen.

Other systems of talking pictures shown in England at the same time were Edison's, Clarendon, and Gaumont. All of the systems were limited by the poor quality and weak volume of the acoustic gramophones of the period, but the Gaumont system made use of C. A. Parson's "Stentorphone," which used a compressed air "supercharger" in the tone arm. This amplified the sound volume very considerably.

Talking pictures reappeared commercially in England about 1925–1926 when de Forest Phonofilms were made at a small studio at Clapham. This studio used a glow-lamp system, which recorded the sound on the side of the picture in the actual motion-picture camera.

From about 1926 onwards, Capt. H. J. Round of Marconi's Wireless Telegraph Company worked upon the photographic recording of sound and in 1929 the Marconi-Visatone system of variable-area sound on film recording was available to Studios. The Visatone Film Recorder was actually the first to utilize the fluid flywheel for eliminating flutter or wows, though in this case it was controlling a specially designed sprocket and not a drum. Capt. Round also designed early equipment for electrical disc recording, used by various British and Continental disc companies. The Vocalian Recording Company made use of it for early transfers of sound-on-film to discs, for use at the many British theaters which were equipped for the disc reproduction only.

Other British systems which achieved some measure of success at about this time were British Phototone, a disc system, and the British Talking Pictures variable-density sound-on-film system, which was a further development of the de Forest Phonofilm. The British Acoustic sound-on-film system was first introduced with a separate film carrying the soundtrack the full width of the film between the perforations, in accordance with the Peterson and Paulsen sound system. This was quickly changed, however, to the normal arrangement of the picture and sound on one film.

In 1928, Ludwig Blattner attempted to market the German Stille system of magnetic recording using steel tape. This was not successful in talking pictures but was taken up and developed by the British Broadcasting Corp.

In 1932, Capt. H. J. Round introduced a method of ground noise reduction to the Marconi Visatone System. This comprised a transparent shutter carrying three black lines of different lengths which intercepted the light in the recorder optical system in accordance with the amplitude of the sound modulation. This successfully avoided infringement of the RCA or British Acoustic patents on ground noise reduction.

At about the same time, I took out a provisional patent for applying ground noise reduction to open-track variable-area recording. This was done by recording an envelope track negative which was double printed over the open track in the laboratory. It was an expensive process of film printing, but enabled me to "silence" several films made at Twickenham Studios just before ground noise reduction was available. The double-print system was used for the preparation of the dialogue re-recording print only, and had the special advantage that the envelope track could be advanced a couple of sprocket holes, thus giving ground noise reduction anticipation and avoiding the distortions due to clipping of transient modulations. Magnetic systems now in use readily enable ground noise anticipation to be used for preparing the final optical negative, a step which gives a major improvement in quality.

Incidentally, most of the gimmicks of the cinema of today seem to have appeared in some form or other years ago and were unsuccessful due to the crude technique of the time. The anamorphic system was exploited in England in about 1919, long before Chretien's system, when Julius Hagen, a British producer, made use of a mirror distorting device with a compression factor of 2:1 in series of "Kinekature" comedies. This was used for comedy effects and was not unscrambled in the projector. It is, therefore, useful as well as interesting to have on record information of every technical gimmick of the earliest days of the cinema; they can often be brought out, cleaned up, and used again.

September 13, 1955

Baynham Honri
Ealing Studios Limited
Ealing Green
London W 5

(Mr. Honri is the Past-President of the British Kinematograph Society.)

Comments by the Author

Mr. Honri's letter is a valuable contribution to the story of the development of sound motion pictures. It helps to fill what I have felt to be the most serious gap in my "History of Sound Motion Pictures" published in the June, July and August issues of the Journal, namely developments abroad. It would be gratifying if others who have firsthand knowledge of developments, which have been overlooked or missed, would follow Mr. Honri's example and submit their stories.

September 29, 1955

Edward W. Kellogg
276 Merion Ave.
Haddonfield, N.J

Television Vertical Aperture Compensation

By A. C. SCHROEDER
and W. G. GIBSON

The known ways of compensating in the vertical direction for a scanning aperture are reviewed. A new method is presented. This consists of wobbling the scanning aperture in and out of focus at a rapid rate, yielding high- and low-resolution signals. The low-resolution signal is subtracted from the high-resolution signal, yielding an aperture-compensated, or edge-enhanced, picture independent of the scanning direction. A similar method using vertical deflection wobble rather than focus wobble results in vertical aperture compensation alone. Pictures are shown to illustrate the subjective improvements obtainable using vertical aperture compensation.

In television, the degradation of the response of a scanning aperture is caused by information belonging to a particular picture element spreading out to neighboring picture elements. Consider a small segment of a television picture comprising nine picture elements as shown in Fig. 1, in which element #1 is the picture element with which we are concerned and elements #2 through #9 are the surrounding picture elements or, more generally, the adjacent surrounding areas. Now if any signal information of elements #2 through #9 of the original scene is present in picture element #1, then the resultant picture is softer depending upon the amount of signal adjacent to picture element #1 which appears in picture element #1. There are various factors which cause information belonging in one picture element to appear also to some degree in a neighboring picture element. A partial list of these factors includes a finite-sized scanning aperture (at pickup device and/or reproducing device), finite depth of focus, optical and electrical focusing components of the system not focused properly, lateral charge leakage in a pickup tube utilizing charge storage, halation and light scattering at glass surfaces, lens aberrations in general, and film grain if film is a part of the system. These factors are cumulative and are especially serious in kinescope recordings or in converting from one set of television standards to another. Aperture compensation is employed to nullify these deleterious effects in order to restore a picture to its original, or at least to some more pleasing, state of sharpness.

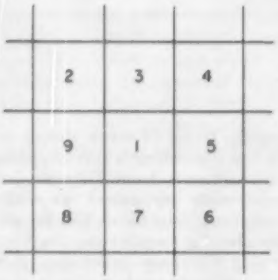

Fig. 1. A small section of a television field.

Presented on October 6, 1955, at the Society's Convention at Lake Placid, N.Y., by A. C. Schroeder and W. G. Gibson, RCA Laboratories Div., Radio Corp. of America, Princeton, N.J. (This paper was received on September 6, 1955.)

Horizontal Aperture Compensation

Due to the television scanning process, aperture compensation by association has been divided into two parts: horizontal and vertical. Horizontal aperture compensation is well known in the art and is accomplished by using electrical circuits that "peak" the higher frequencies with respect to the lower and that have the proper phase response (linear phase is normally required).[1]

Neglect of Vertical Aperture Compensation

Vertical aperture compensation has been virtually ignored in the television art due mainly to two reasons: (1) lack of information on how to perform the operation and (2) failure to realize the desirability of the operation. The first reason exists because previously known means have been extremely complicated to employ. The desirability of the operation

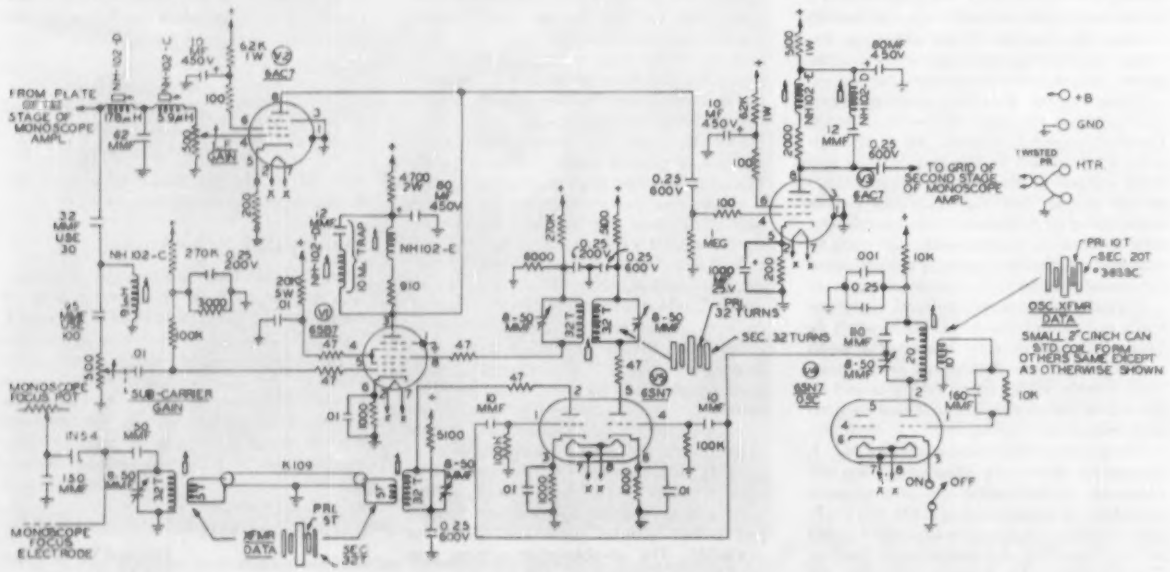

Fig. 2. Monoscope aperture compensator.

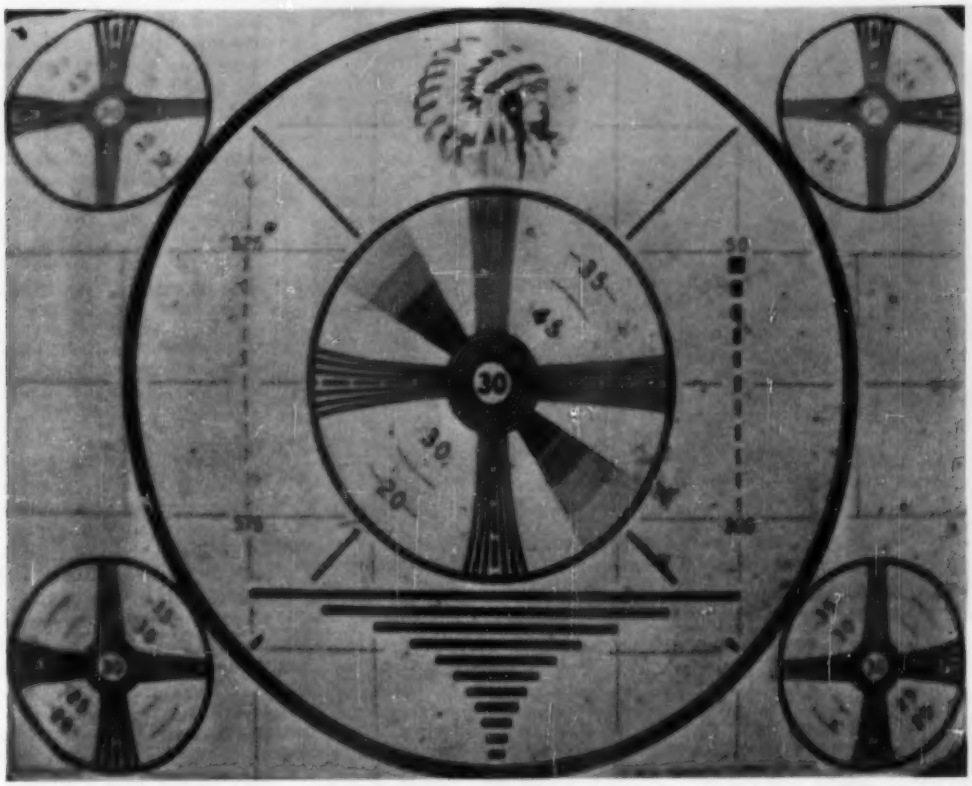

Fig. 3. Standard monoscope pattern.

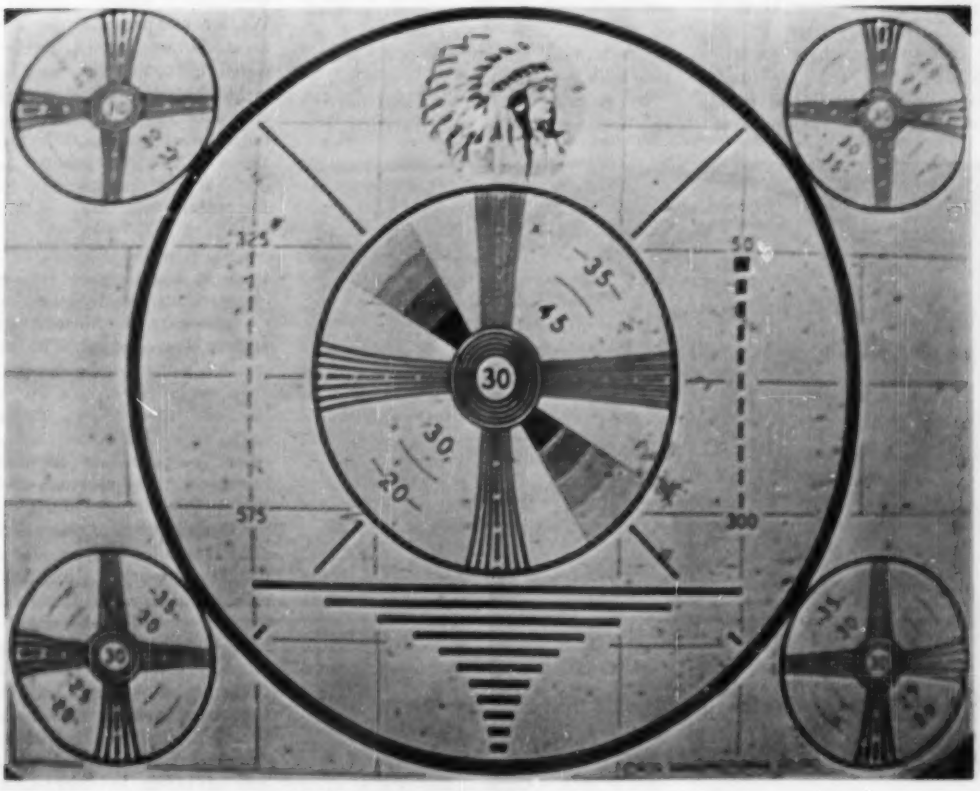

Fig. 4. Monoscope pattern with aperture compensation.

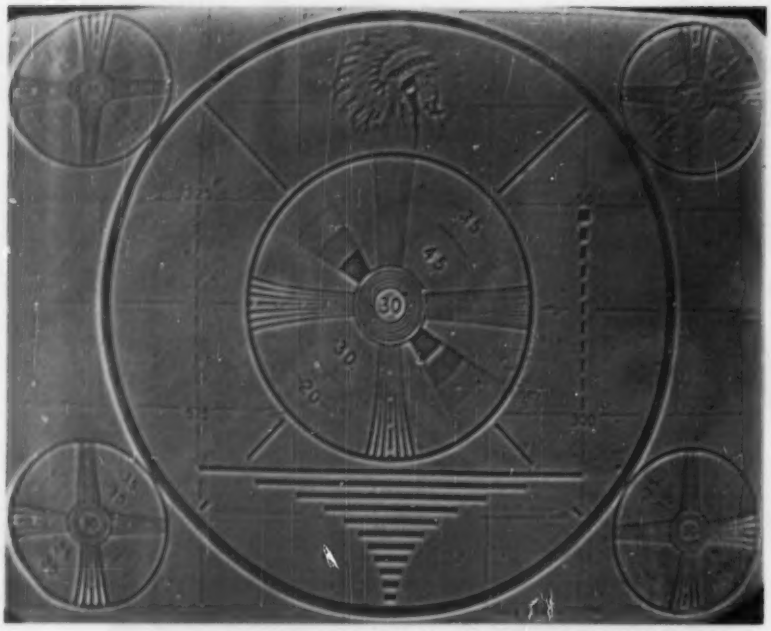

Fig. 5. Difference signal of Eq. (6).

was not appreciated because the scanning process complicated the measurement of vertical resolution. The line structure also puts a discontinuous factor into vertical detail which tends to hide some vertical softness, although it does not contribute any true sharpness to the image. Taking into account vertical blanking which can vary from 5% to 8% of the picture time, there are approximately 490 active scanning lines. Using a high "Kell factor"[3,5] of 0.85, one obtains an expected resolution of approximately 415 lines which can usually be obtained in broadcasting practice so that the system rather than aperture losses has appeared to be the dominant factor in the vertical direction. However, the type of observation normally made tells nothing of the relative amplitude of the detail contrast at 415 lines. The "Kell factor" is a measure of the effectiveness of the scanning lines in reproducing vertical detail.

In general, the factors that affect aperture response in one direction affect it in all directions about the same amount, so that if the application of horizontal aperture compensation is beneficial to the signal, the application of vertical aperture compensation would also be beneficial. In kine recording, vertical spot wobble is often used to reduce scanning line moirés, and this softens the aperture response vertically but not horizontally. This is an exception to the above-mentioned rule.

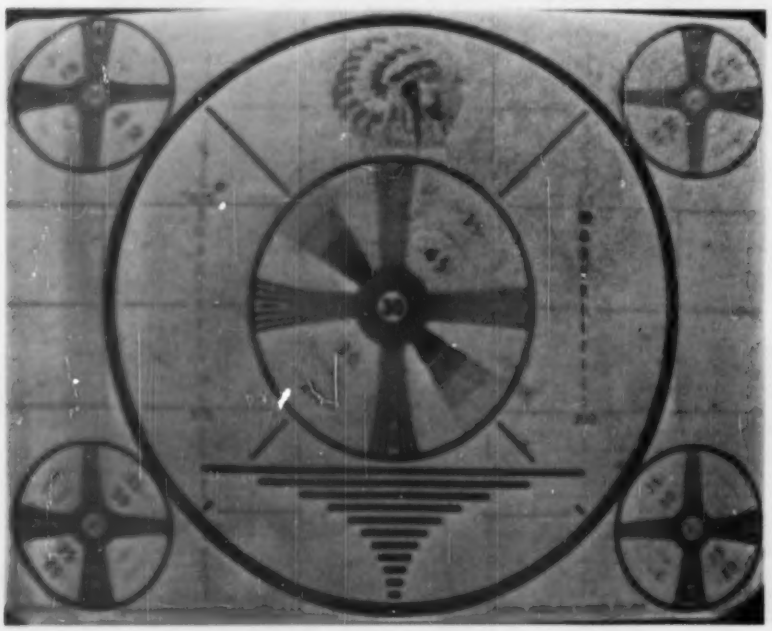

Fig. 6. Sum signal of Eq. (4).

Focus Wobble Aperture Compensation

Referring again to Fig. 1, aperture compensation can be accomplished both horizontally and vertically by subtracting the proper amount of the information in elements #2 to #9 from the information in picture element #1. If the shape of the scanning aperture varies at a rapid rate from a small square just filling picture element #1 to a squarish ring filling elements #2 to #9, then the electrical signal from the pickup device contains the two pieces of information, following each other very closely in time, required for the subtraction operation. By means of synchronous detection the two signals can be separated out and the proper difference signal obtained. Practically, it is difficult to vary the shape of the scanning aperture as described above, but it is fairly easy to vary rapidly from a focused spot to a defocused spot. We are not restricting ourselves to compensating for only the immediately adjacent picture elements. We are compensating for the adjacent areas. Subtraction of the focused spot signal from the defocused spot signal yields the desired ring spot signal. The ring spot signal is desired in order to be subtracted from the focused spot signal. These two subtractions can be done in one operation, of course. The first subtraction is

$$e_r = e_d - c_1 e_f \qquad (1)$$

where e_r represents the ring spot signal, e_d represents the defocused spot signal, e_f represents the focused spot signal, and c_1 is a constant. The second subtraction is

$$e_c = e_f - c_2 e_r = e_f(1 + c_1 c_2) - c_2 e_d = c_3(e_f - c_4 e_d) \qquad (2)$$

where c_3, c_3, c_4 are constants, and e_c represents the aperture-compensated signal. Equation (2) states that the desired aperture compensation requires only that a certain amount, c_4, of the defocused spot information is to be subtracted from the focused spot information. (It might be noted here that if the focused spot itself is larger than a picture element, the method still works. It merely means that e_f of Eq. (2) contains some defocused information. This can be overcome by an appropriate change in the value of c_4.) These two desired pieces of information can be obtained by a modulation process. The

signal from the pickup tube can be considered as a time multiplexed signal and can be expressed as,

$$S_o = e_f[A_o + A_1 \cos \omega t + A_2 \cos 2\omega t + \ldots\ldots\ldots\ldots] + e_d[B_o + B_1 \cos(\omega t + 180°) + B_2 \cos(2\omega t + 360°) + \ldots] \quad (3)$$

where S_o is the signal from the pickup tube, the A's and B's are constants determined by the waveshapes of the multiplexing process, the A's being the in-focus signal and B's the out-of-focus signal, and ω is the radian frequency at which the spot is wobbled in and out of focus. This frequency should be at least twice as high as the highest signal frequency so that there will be no signal overlapping. If this signal from the pickup device is passed through a low-pass filter, Eq. (3) reduces to,

$$S_1 = e_f A_o + e_d B_o \quad (4)$$

If the signal is passed through a band-pass filter centered at ω and then multiplied by $\cos \omega t$, one obtains,

$$S_2 \cos \omega t = [e_f A_1 \cos \omega t + e_d B_1 \cos(\omega t + 180°)] \cos \omega t = \frac{e_f A_1}{2} + \frac{e_f A_1}{2} \cos 2\omega t - \frac{e_d B_1}{2} - \frac{e_d B_1}{2} \cos 2\omega t \quad (5)$$

Passing the signal of Eq. (5) through a low-pass filter yields,

$$S_3 = e_f \frac{A_1}{2} - e_d \frac{B_1}{2} \quad (6)$$

Adding Eqs. (4) and (6) yields,

$$S_1 + S_3 = \left(A_o + \frac{A_1}{2}\right) e_f + \left(B_o - \frac{B_1}{2}\right) e_d = c_0(e_f + c_1 e_d) \quad (7)$$

where the polarity and value of c_1 are determined by the amount of Eq. (6) that is added to Eq. (4) and by the relative values of B_o and B_1. Equation (7) indicates that the operations required in Eq. (2) have been performed.

Figure 2 is a schematic of this process as actually applied to a monoscope camera tube. V4 is the oscillator which, via one-half of buffer V5, applies a 10-mc cosine wave to the focusing electrode and, via the other half of buffer V5, applies the same frequency to modulator tube V1 in order to obtain the difference signal of Eq. (6). The phase is adjusted by mistuning one of the tuned circuits. The phase of the modulating cosine wave is not critical. If it is off by 45°; the output of the modulator is down only by 30%. V1 gets the proper video signal from the plate of the first stage of the monoscope video amplifier via a high-pass filter, and V2 gets the signal of Eq. (4) via a low-pass filter. The gain controls on the inputs to V1 and V2 are used to control the amount of aperture compensation employed. The plates of V1 and V2 are tied together to obtain the signal of Eq. (7). V3 inverts and feeds the aperture-compensated signal back to the monoscope video amplifier for further amplification. Figures 3, 4, 5 and 6 are photographs of various parts of the above signals as seen on a 10-in. black-and-white monitor. The limiting resolution has deteriorated slightly since a rather low wobbling frequency of 10 mc was employed. Since the monoscope scanning aperture is very good to start with, the result in order to be seen is adjusted to be an edge-enhanced picture. In passing, it might be added that this application of two-dimensional aperture compensation, done by means of focus wobble on an existing monoscope camera, required only five vacuum tubes and has required no maintenance in over 1000 hours of operation.

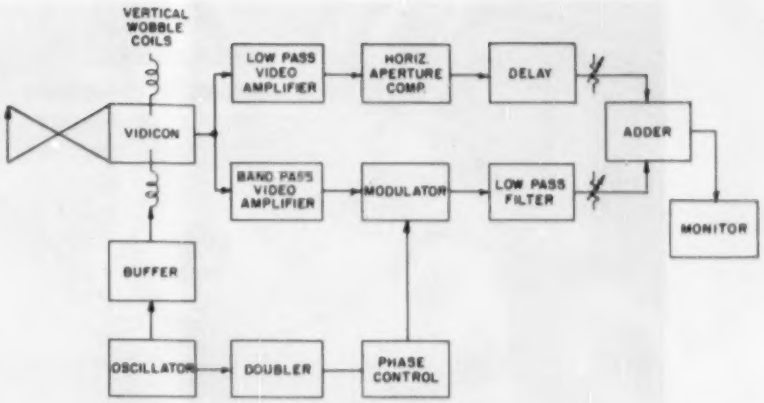

Fig. 7. Vertical wobble aperture compensation applied to a vidicon.

The compensation achieved is affected by the size, ellipticity and radial electron density of the defocused spot. By properly shaping the spot, for example, more compensation could be done in the horizontal direction. Conversely, by defocusing the scanning aperture in the vertical direction only, vertical aperture compensation alone is achieved. However, this restricted type of defocusing is rather difficult to perform.

It should be noted here that compensation is required for the reproducing aperture, also. It is realized that the eye has an aperture response also but that is not being considered in this paper.[4] Psychological factors, not investigated by the authors, will determine whether the eye desires more (or possibly less) edge-enhancement when viewing a reproduction than when viewing an original scene.

Reference 4 has curves showing the aperture responses of some pickup devices, lenses, film and kinescopes. When these are considered in cascade, the total aperture losses can be considerable.

Vertical Wobble Aperture Compensation

Referring again to Fig. 1, vertical aperture compensation alone with respect to picture element #1 can be accomplished by subtracting part of the signal information of elements #3 and #7 from the signal information of picture element #1. The information in elements #3 and #7 can be obtained by wobbling the spot vertically and then employing synchronous detection on the signal coming out of the tube to separate the two pieces of information. The signal out of the tube can be expressed as,

$$S_o = e_L[A_o + A_1 \cos 2\omega t + A_2 \cos 4\omega t + \ldots\ldots\ldots\ldots\ldots\ldots] + e_{L-1}[B_o + B_1 \cos(\omega t + 90°) + B_2 \cos(2\omega t + 180°) + \ldots\ldots\ldots] + e_{L+1}[C_o + C_1 \cos(\omega t + 270°) + C_2 \cos(2\omega t + 540°) + \ldots] \quad (8)$$

where e_L represents the signal on the line being scanned, e_{L-1} and e_{L+1} represent the signals on the preceding and succeeding lines, and ω represents the radian frequency of vertical wobbling. Passing this signal through a low-pass filter yields,

$$S_1 = A_o e_L + B_o e_{L-1} + C_o e_{L+1} \quad (9)$$

and passing this signal through a band-pass filter centered around 2ω, multiplying by $\cos 2\omega t$, and passing the product through a low-pass filter yields, analogously to Eq. (5),

$$S_3 = A_1 e_L - B_1 e_{L-1} - C_1 e_{L+1} \quad (10)$$

Due to the symmetry of vertical wobbling, the B's and C's can be assumed to be equal so that the sum of Eqs. (9) and (10) is,

$$S_1 + S_3 = (A_o + A_1)e_L + (B_o - B_1)(e_{L-1} + e_{L+1}) = K_1[e_L + K_2(e_{L-1} + e_{L+1})] \quad (11)$$

where the polarity and value of K_2 are

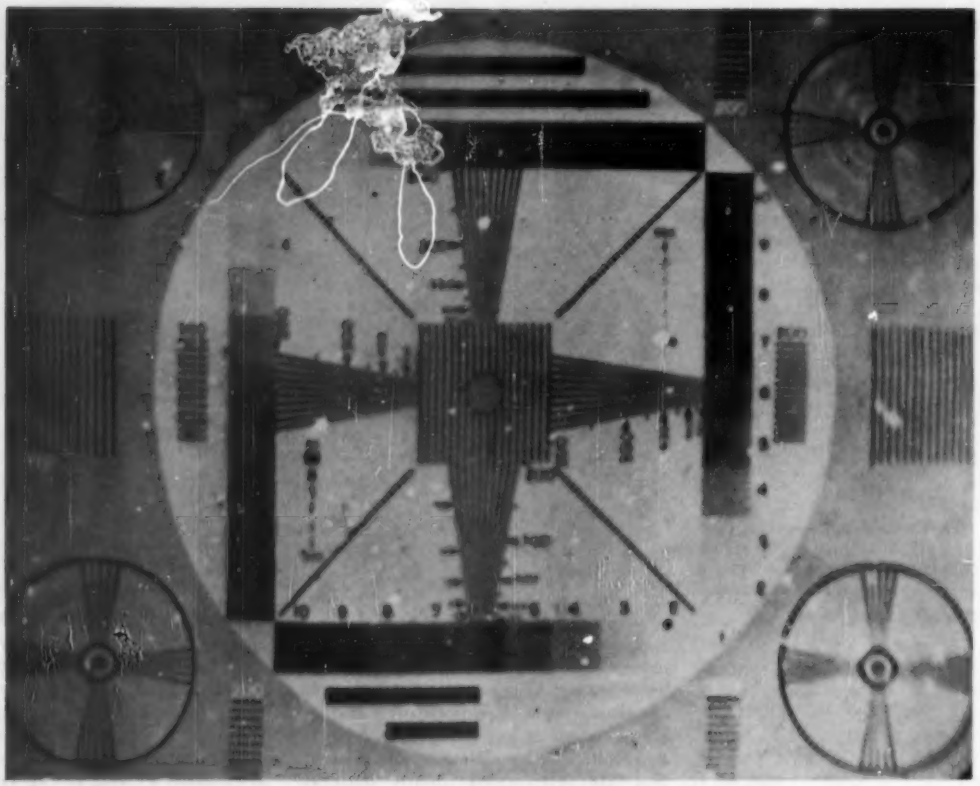

Fig. 8. RETMA Test Pattern, vidicon pickup.

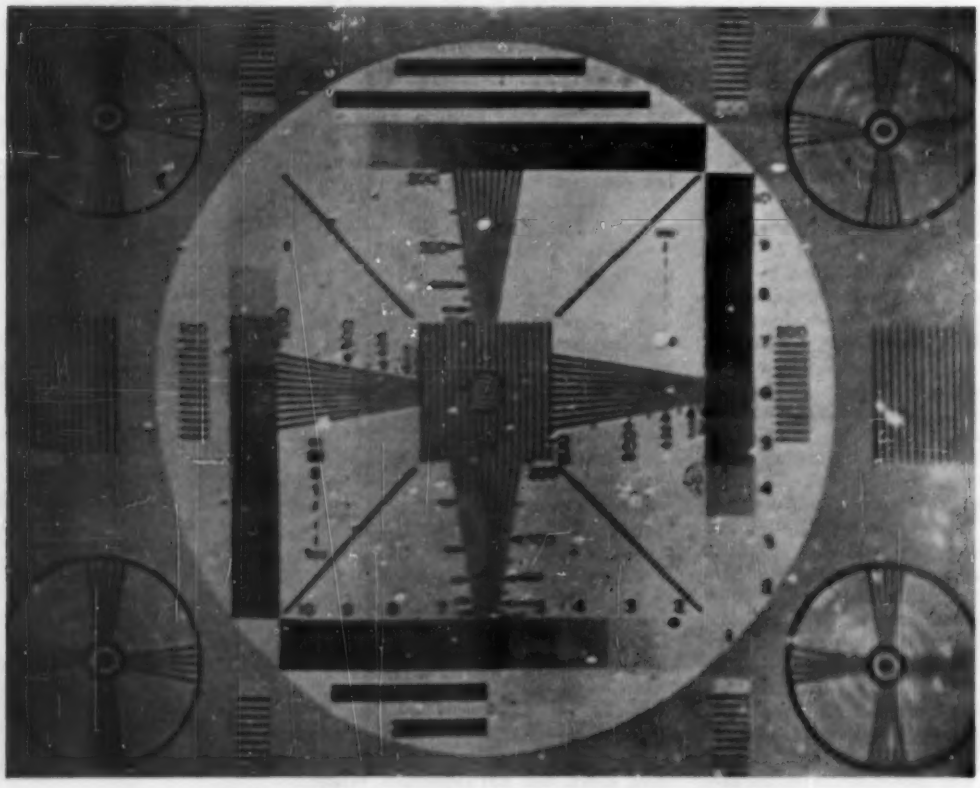

Fig. 9. RETMA Test Pattern, with vertical aperture compensation.

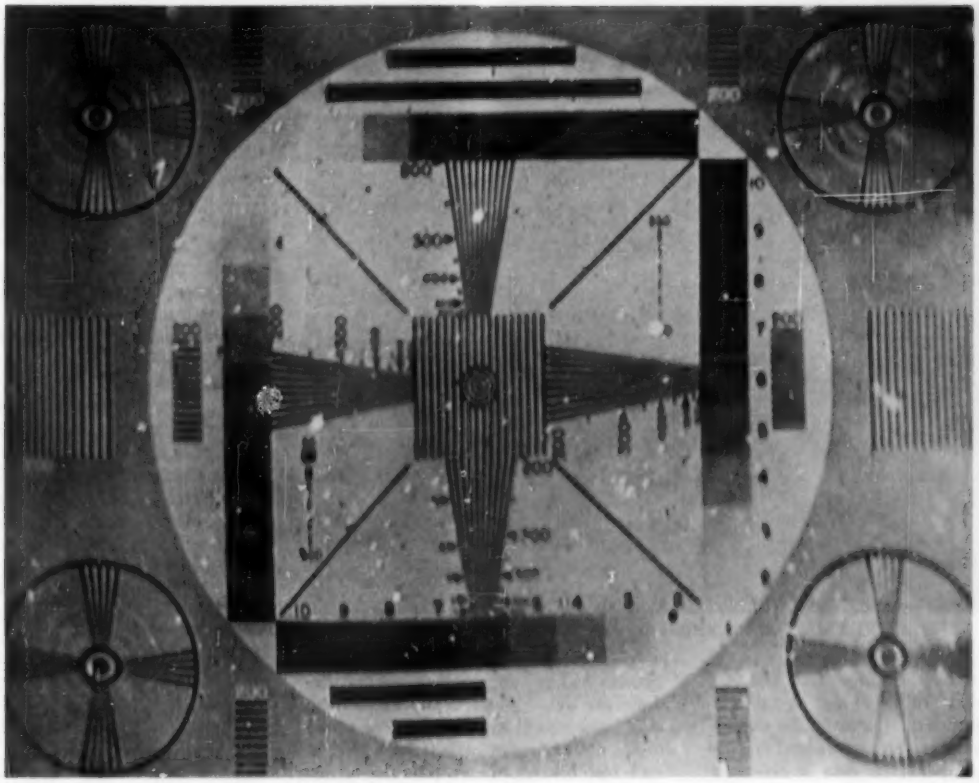

Fig. 10. RETMA Test Pattern, with horizontal aperture compensation.

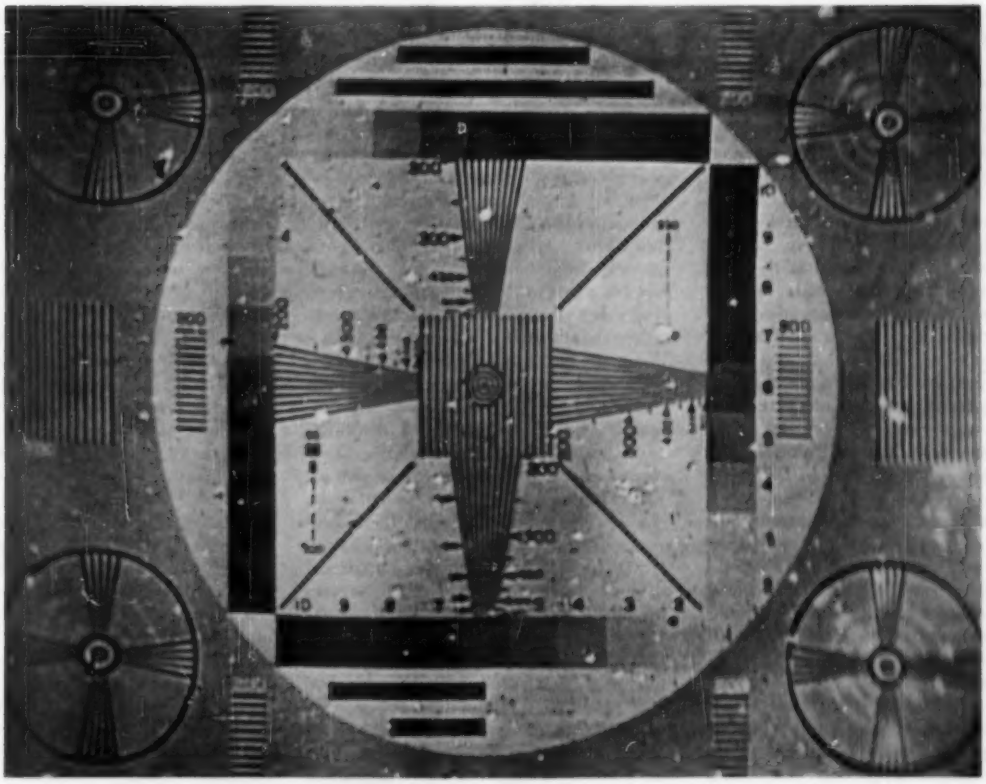

Fig. 11. RETMA Test Pattern, with combined aperture compensations.

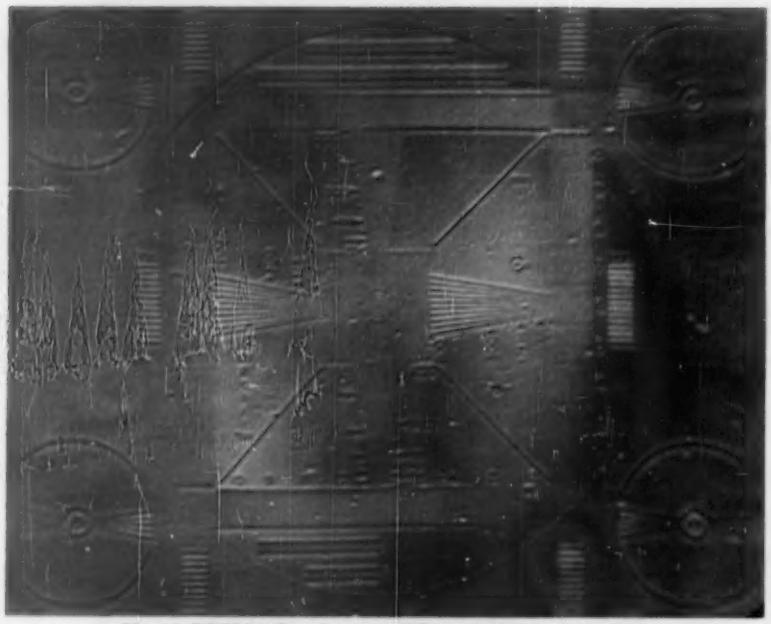

Fig. 12. RETMA Test Pattern, difference signal of Eq. (10).

determined by the amount of Eq. (10) that is added to Eq. (9) and by the relative amplitudes of B_o and B_2. By making K_2 negative, varying amounts of vertical aperture compensation may be achieved.

In the case of focus wobble aperture compensation, the signal from the tube was modulated by $\cos \omega t$, and in the case of vertical wobble aperture compensation, the signal from the tube was modulated by $\cos 2\omega t$. In Fig. 2, the 1N54 crystal diode connected to the monoscope focus electrode permits defocusing in one direction of the voltage swing only, along with a simple means of switching the compensation in and out for testing (the switch in the cathode of the oscillator). This eliminates the need for a frequency-doubler to generate $\cos 2\omega t$. If the focus electrode potential were varied on both sides of focus by the wobble voltage, $\cos \omega t$, then $\cos 2\omega t$ would have been required for later modulation of the signal, rather than the same frequency $\cos \omega t$. In the case of vertical wobble aperture compensation, the information on opposite sides of the point in question is desired so that modulation by $\cos 2\omega t$ is required.

This process has been applied to a vidicon pickup tube. A pair of small coils was mounted inside the deflection yoke and a 10-mc voltage was applied, wobbling the beam vertically. Figure 7 is a block diagram of the circuits used. Figure 8 is a test pattern without aperture compensation; Fig. 9 is the same pattern with only vertical aperture compensation applied; Fig. 10 is the same pattern with only the usual type of horizontal aperture compensation; and Fig. 11 is the same pattern with both vertical and horizontal aperture compensation. The compensations were overdone on the original photograph since it is hard to tell in advance how much of the compensation will be removed in each step of the photographic and printing processes. Figure 12 is the difference signal of Eq. (10) of this same test pattern. Figs. 13, 14, 15, 16 and 17 show the effects of aperture compensation on a scene rather than on a test pattern. The image source was a 2 x 2-in. slide projected onto the target of the vidicon.

The limiting resolution of the vidicon used in these experiments is rather poor. Standard commercial vidicons were not used because the focus electrode shielded the beam too well from the 10-mc vertical wobble field. Fortunately, a laboratory vidicon which had been made for another purpose was available which had a mesh screen rather than a solid sheet focus electrode. The mesh-screen focus electrode allowed the high-frequency 10-mc alternating magnetic field to wobble the electron beam vertically. Unfortunately, nothing could be done about the blemishes and somewhat poor resolution which were in this experimental type of vidicon. It can be observed that the blemishes sharpen up and become more noticeable with the use of aperture compensation.

The compensations described so far are the first-order corrections, as using one tap on a delay line in a transversal filter for horizontal aperture compensation is a first-order correction.[1,5] By using additional modulators set at different phases one could obtain separate signals corresponding to different distances from picture element #1 to enable subtraction (or addition) of different amounts of information in picture elements farther removed from picture element #1.

The amount of aperture compensation that can be employed is often limited by the signal-to-noise ratio of the signal being compensated. Applying vertical aperture compensation increases the noise in the same manner as conventional horizontal aperture compensation does. In the practical case, there are advantages to the home viewer if, when complete compensation is limited by noise considerations, some of the compensation is applied in the vertical direction. This reduces the too familiar ringing on edges but, for the first-order correction, puts a maximum of one overshoot in the vertical direction. In addition, a cheap receiver benefits directly from vertical aperture compensation applied at the transmitter but if it has a narrow video passband, the effects of horizontal aperture compensation may be nullified completely.

Field Delay Vertical Aperture Compensation[6]

In the preceding section, vertical aperture compensation was accomplished by subtracting information in elements #3 and #7 from picture element #1. The information in elements #3 and #7 was obtained by wobbling the scanning aperture vertically at a rapid rate. Another way of obtaining this information in elements #3 and #7 is to use a video delay of one field plus and minus one-half line. Due to interlaced scanning, delays of one line pertain to information displaced two lines from the picture element in question, so that delays of the order of one field are required to get the information above and below the point in question. Due to the odd number of scanning lines in one frame, a field consists of an integral number plus one-half scanning lines so one-half line must be subtracted and added to one field to get directly above and below the point in question. Having obtained the delay, the vertically adjacent information is merely subtracted in the right amounts from the main signal. If the information to be subtracted in element areas #3 and #7 extends beyond one line away from picture element #1, then delays of only one line are necessary to get additional information one line farther away to be subtracted from the main signal. The process merely gets more complex as one compensates farther out. However, it has been extremely difficult to get accurate delays of the order of one field so that practically nothing has been done along these lines. Distributed, lumped constant and quartz-type delay lines appear to be impractical at the present state of the art. Tape recording, however, does offer an enticing possibility of being able, sometime in the future, to construct

a "black box" which will accomplish vertical aperture compensation of a signal from an inaccessible pickup device. A rotating magnetic drum with a recording head and various reading heads would be the heart of such a black box in obtaining the long delays required, and associated circuitry would perform the necessary operations. By merely adding additional reading heads to this type of device one could correct as far away vertically as desired.

The two wobble types of aperture compensation already described require that the information be in a two-dimensional pattern, but this delay method does not. It operates on any one dimensional, time-varying, television type of signal. Therefore, one black box employing the delay type of vertical aperture compensation could be used for several pickup devices. It could also be used to operate on the video signal which is applied to a kinescope in making kine recordings. In this case it might be overdone to compensate in advance for later defects occurring in the complete recording process and playback.

Criss-Cross Scanning

Another means of accomplishing vertical aperture compensation is to use two different directions of scan. In converting from field-sequential to simultaneous color television, for example, it is advantageous to scan in the sequential pickup equipment at 90° from the standard scan so that scanning line moirés will not be produced. Using usual horizontal aperture compensation on the field-sequential signal results in vertical aperture compensation in the final converted signal.[7]

Vertical aperture compensation has been accomplished using high-frequency peaking and a "criss-cross" diagonal scan which is incompatible with present television standards.[8]

Entire-Picture Subtraction

Two pickup tubes can be employed for aperture compensation. The two tubes are registered, both optically and electrically, so that they yield identical output signals. The second tube is defocused, and its signal is subtracted from the signal from the first tube. Since the subtracting signal from the second tube is defocused, it removes large-area information from the signal from the first tube but it does not affect the fine detail. The result is an edge-enhanced picture, irrespective of scanning direction. This method has been used in the photographic process.[6,9] It has also been done by using image-orthicon and vidicon pickup tubes.[10]

Image-Orthicon Halo

If an image-orthicon pickup tube is operated over the knee, all of the secondary electrons from the glass target are not collected by the mesh but some fall back upon neighboring areas of the target.[11] This results in a reduction in large-area contrast but not in detail contrast. It is not what one would call aperture compensation because it is a function of the scene content and does not necessarily correct detail exactly as desired. However, it does yield edge-enhancement independent of the scanning direction and is mentioned for that reason. It is seen quite often on commercial broadcast television. An example is the dark lapels on a man's suit often seen next to a white shirt.

Storage Tubes

Storage tubes (or storage devices) can be utilized in various ways to make a black box that will perform two-dimensional or vertical aperture compensation on a signal without having access to the signal source. The wobble methods can be employed in a storage tube by performing the appropriate wobble operation on the reading scanning aperture. The field (plus and minus one-half line) delay method can be employed by using two storage tubes, raising the vertical reading aperture one line on one storage tube and lowering the vertical reading aperture one line on the other storage tube,[6] to get the information directly above and below the point in question. These two signals are then subtracted in the proper amount from the main signal. The criss-cross scanning method can be employed by using two storage tubes in cascade, having both the first reading aperture and the second writing aperture scanning at 90° from the normal scan and employing standard horizontal aperture compensation on the signal existing between the two storage tubes. Entire-picture subtraction can be employed by having either one or both of the writing and reading scanning apertures out of focus. The soft picture from the storage tube is then subtracted from the delayed main signal yielding an edge-enhanced picture. The practical difficulties in using storage tubes for aperture compensation lie in image-registration problems and linearity of transfer-characteristic problems. It is very easy to lose more in picture quality than is gained in a conversion process.

Line-Structure Compensation

The methods for two-dimensional aperture compensation and for vertical aperture compensation as described so far have been concerned with increasing the detail contrast in all directions or in the vertical direction only, depending upon the process. The desired result is an amplitude vs. "frequency" function similar to (possibly identical to) a normally compensated horizontal-direction amplitude response except for the fact that resolution in the vertical direction is broken up, or sampled, by the scanning lines. The usual shapes of scanning apertures employed do not keep flat response vertically out to the number of scanning lines.[4,12] In addition, the response at the high end is a function of the position of the detail. Scanning apertures at pickup and receiver with a sin x/x response in the vertical direction, however, will keep full response out to the line number, and then cut off sharply, and be free of moirés in repeating patterns and serrations on diagonal lines and have no visible line structure. The "Kell factor" is unity, of course. This can be seen by analogy to the horizontal dimension.

If on the time axis of an arbitrary function, $S(t)$, equidistant "sampling points" are marked off, spaced by $\Delta t = 1/2F$ starting with $t = 0$, and if to every point $t_n = n/2f$ a function

$$U_n = \frac{\sin 2\pi F\left(t - \frac{n}{2f}\right)}{2\pi F\left(t - \frac{n}{2F}\right)} \qquad (12)$$

is associated, then one obtains the "cardinal function" by forming the series

$$[S(t)] = \sum_{n=-\infty}^{\infty} S(t_n)\, U_n(t) \qquad (13)$$

In the waveband, F, the signal, $S(t)$, is completely determined by $[S(t)]$, and the frequency spectrum of $[S(t)]$ is zero outside the frequency band between $-F$ and F.[13]

Now in television the line-scanning process can be looked at as a sampling process in the vertical direction, so that if one wishes to get full amplitude response out to 525 lines (minus blanking of course) by means of this sampling process, one then uses scanning apertures at both transmitter and receiver that are sin x/x functions (with zeros occurring at line pitch). The sin x/x scanning aperture is required at the receiver because the process of forming the "cardinal function" is not complete until the signal information has been laid down again in the form of a viewed picture. Sin x/x scanning apertures have been difficult to obtain. However, by means of vertical deflection wobble or by means of field and line delays one can obtain the information as far away as one chooses above and below the line being scanned, and by adding or subtracting the proper amounts of the signals on successively adjacent lines from the signal on the line being scanned, one can approximate a sin x/x scanning aperture distribution in the vertical direction as close as one chooses with the pickup camera. In a similar way, focus wobble could be employed to approximate a two-dimensional sin x/x scanning aperture distribution.

Since there is no known way of generating negative light, a sin x/x scanning aperture at the reproducer is unrealiza-

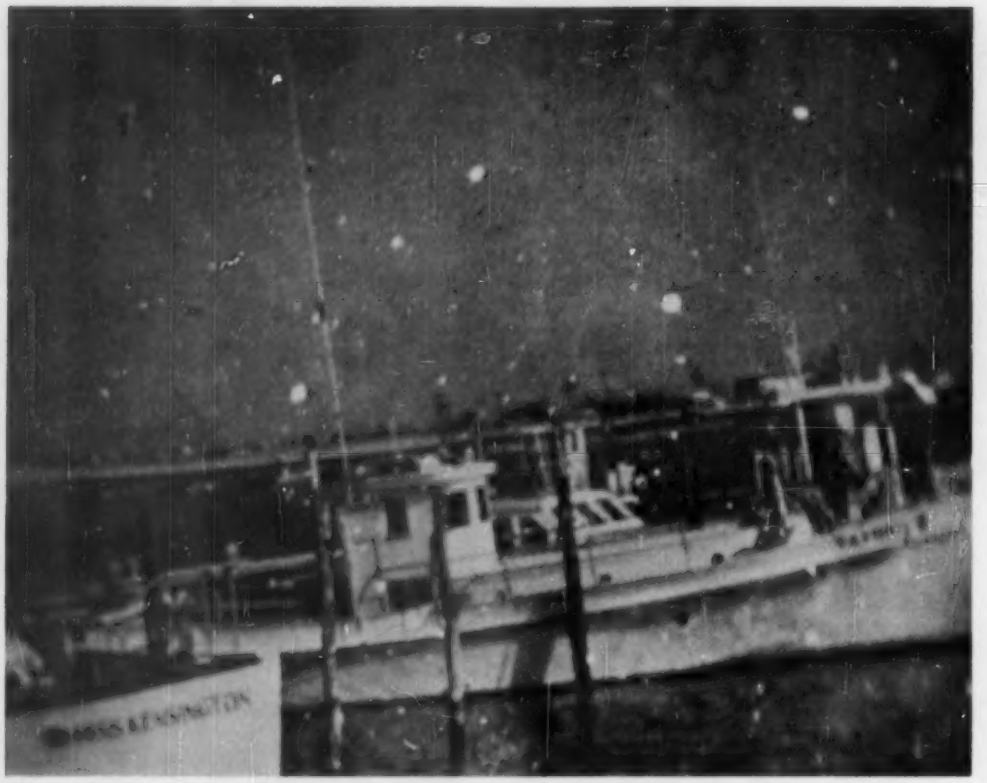

Fig. 13. Vidicon pickup, no aperture compensation.

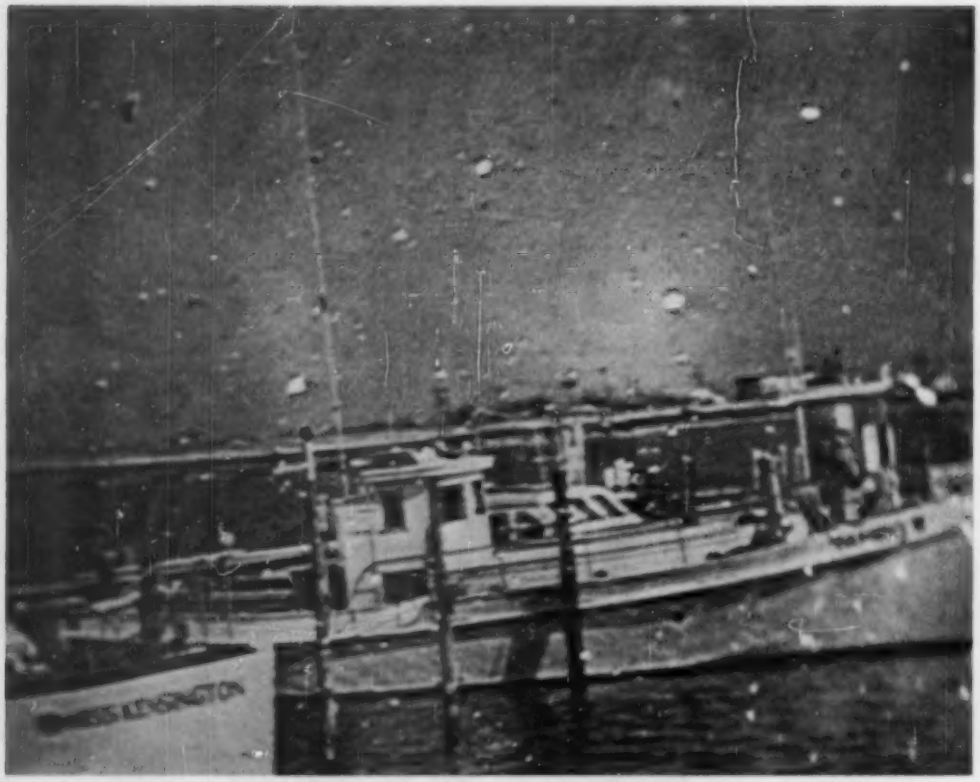

Fig. 14. Vidicon pickup, with vertical aperture compensation.

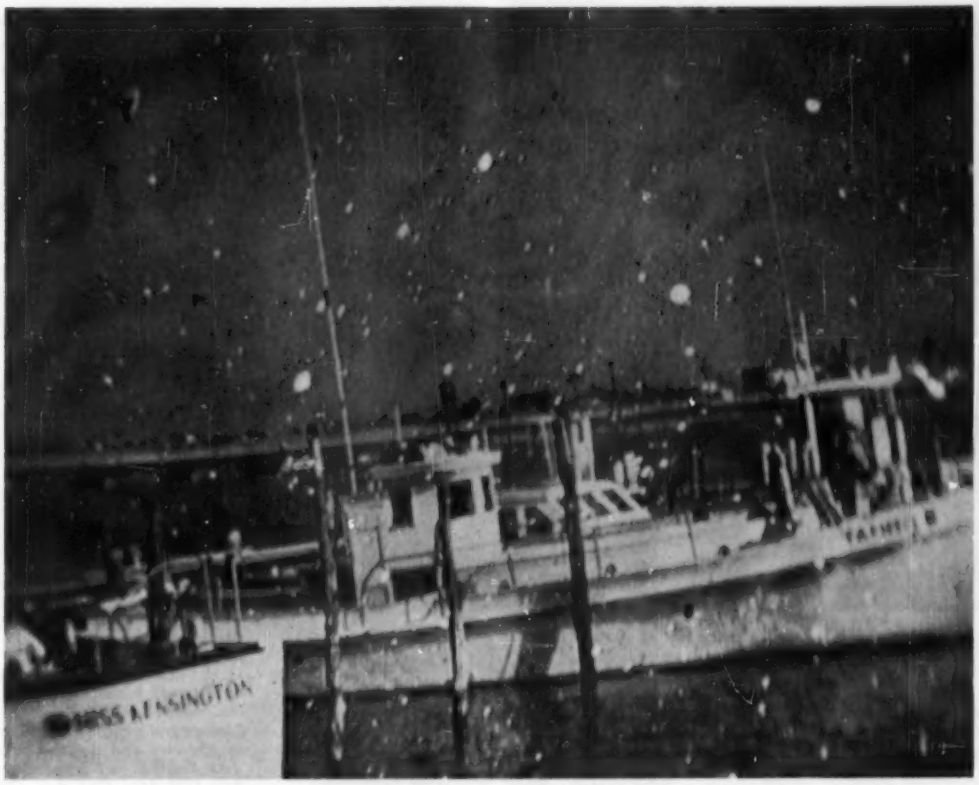

Fig. 15. Vidicon pickup, with horizontal aperture compensation.

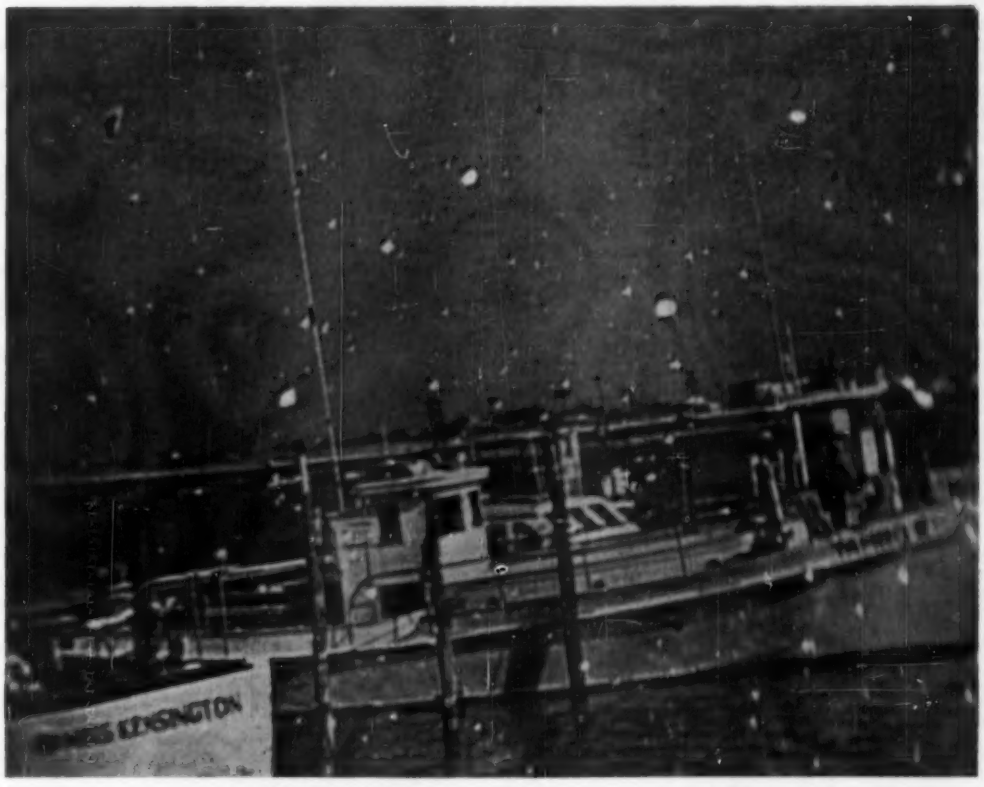

Fig. 16. Vidicon pickup, with combined aperture compensations.

Fig. 17. Difference signal of Eq. (10).

ble. Some other aperture distribution, cosine squared for example, will yield a flat field, i.e., no visible scanning structure, at the receiver. By either modifying the sin x/x scanning aperture distribution or by using more vertical-aperture compensation at the pickup end of the system (two different ways of looking at the same thing, in this case), the imperfections of the reproducing aperture as regards line structure can be compensated for somewhat, especially where the reproducing aperture is not called upon to deliver negative light.

In the past an infinitesimally small scanning aperture has been considered to be ideal. This still holds in the horizontal direction at both pickup and reproducer because at pickup, after sharp cutoff low-pass filtering, it is equivalent to a sin x/x scanning aperture and at the reproducing aperture it is equivalent to a wide-band continuous display not degraded by a sampling process. However, due to the scanning process, a sin x/x scanning aperture response in the vertical direction at both pickup and reproducer offers considerable theoretical improvement in picture reproduction over an infinitesimally small scanning aperture. It has not been calculated how much of this theoretical improvement can be realized by using a sin x/x scanning aperture (or some modification thereof) at the pickup only and a scanning aperture at the reproducer which cannot supply negative light.

Conclusions

There are a number of ways to accomplish aperture compensation in the vertical direction. In some instances, there is a considerable subjective improvement in sharpness that can be realized. Unfortunately, it is usually quite complicated equipment-wise to employ vertical aperture compensation at the present state of the art. The allowable signal-to-noise ratio is a factor also. However, the use of "wobble" techniques and the use of a magnetic drum for long storage should help to make the use of vertical aperture compensation more general.

By means of scanning apertures with complicated distributions, such as sin x/x in the vertical direction, it may be possible in the future to have television pictures with uniform vertical response out to the number of scanning lines employed and with no evidence of line structure, due both to a flat field and to the absence of serrations on diagonal lines and moirés in repeating patterns.

Acknowledgment

The encouragement of R. D. Kell in this project is gratefully acknowledged.

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A Uniform Blackbody Light Source Excited by Radio Frequency

By SANFORD C. PEEK

The need for a new light source of greater stability, higher brightness and better uniformity is mentioned. The development program which resulted in such a lamp (which has blackbody radiation) is then discussed. Actual performance in a 35mm printer and a 16mm projector is presented with mention of other possible applications.

When one wishes to choose a light source for a particular application, he is generally interested in obtaining the best compromise among the following properties:

1. Brightness
2. Source Size
3. Source Shape
4. Spectral Distribution
5. Uniformity of the Source
6. Stability of the Source

Each use places emphasis on different properties or combinations of properties. There never seems to be an ideal light source for any given application, and it is therefore up to the user to design his fixture or optics to make the best of any limitations that are inherent in the lamp. Filters, diffusers, relay optics and special reflectors are all illustrations of this point.

There is need in photography for a multitude of kinds of lamps. General lighting of the subject requires large, distributed sources; projection needs small, bright, uniform sources; printers put emphasis on spectral distribution and source uniformity. The purpose of this paper is to describe a new light source specifically designed for those applications which need small, bright, uniform sources. Such a lamp is required when the optics involve a rather narrow pencil of light rays, such as:

1. Projection
2. Printing
3. Microscopy

Source Requirements for Illumination of Small Areas

If the illumination of a small area is the only criterion, then a uniform source can be either magnified or demagnified to cover the object. It might seem at first glance that we can get more illumination by using large sources demagnified than small ones magnified. This would be true if it were possible to use all the light radiated from the source. As the magnification is increased, however, the solid angle intercepted by the condensing lens becomes smaller and smaller, and the point of diminishing returns finally arrives. Figure 1 shows how the amount of light that can be imaged on an object varies with the magnification of the system. This assumes that the object size is held constant and that the source is of constant brightness. The source size is varied and the magnification changed accordingly.

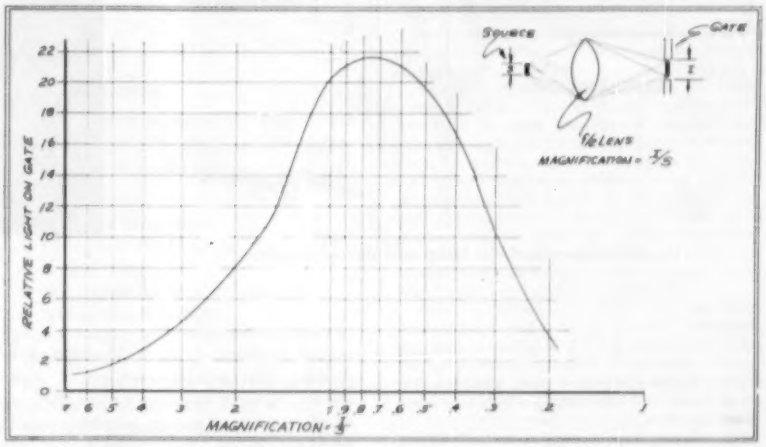

Figure 1

Now if optical limitations beyond the object impose restrictions on the solid angle of the pencil of light rays so that all the lenses will be filled, a more serious requirement is placed on the source size (Fig. 2). There follows a simple algebraic treatment of this situation.

Assume a source of diameter, s is imaged on a gate of diameter, I, by means of a lens of diameter, D. u and v are the distances between the source and the lens and the image and the lens respectively. It is necessary to maintain a definite ratio of v to D in order to fill properly any optics which may follow the image. We can therefore say v/D = a constant = k.

Figure 2

The amount of light that is contained in the image is proportional to the following:

1. The brightness of the source, B
2. The area of the source, πs^2
3. The proportion of the total light intercepted by the lens, D^2*$/u^2$

Therefore, the total light w is proportional to

$$w \sim \frac{D^2 s^2 B}{U^2}$$

Since $v/D = k$ then $D^2 = v^2/k^2$

or $w \sim \frac{v^2}{u^2} \cdot \frac{s^2 B}{k^2}$ or $w \sim \frac{v^2}{u^2} \cdot s^2 B$

since k is a constant.

It is well known that the magnification m is equal to v/u if the source is imaged. Therefore $w \sim m^2 s^2 \cdot B$.

Now if the source is small, we must increase the magnification or if the source is large, we must reduce the magnification. In fact, $ms = I$ or if the gate is fixed as it is in the case of a film gate, ms is a constant. It is then clear that the total light that can be used is proportional only to the brightness of the source.

$$w \sim B$$

There is another important point. The f number of the lens is F/D, where F is the focal length of the lens. Also the focal length is related to u and v as follows:

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(This paper was received September 14, 1955.)

* This assumes that the light is radiated equally in all directions from the source, which is a good approximation for most practical cases. It is derived from the following:
The area of intercepted light is $\pi D^2/4$.
The total area of emitted light is $4\pi u^2$.
The ratio of the two is $D^2/16u^2$, but since we are considering only proportionality it is D^2/μ^2.

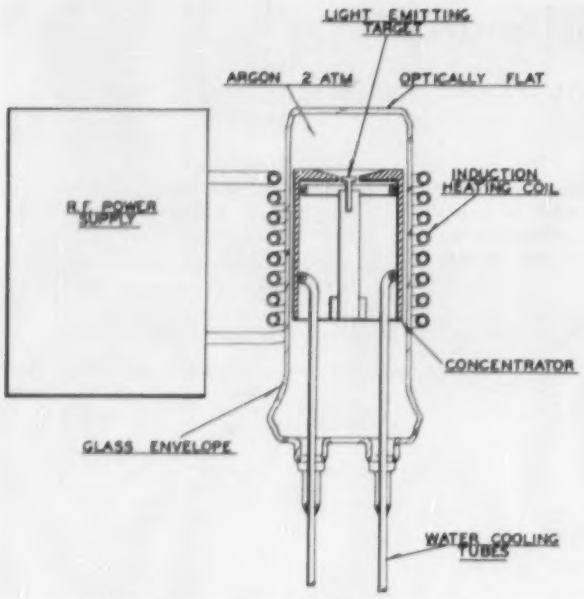


Fig. 3. Schematic of the lamp and power supply.

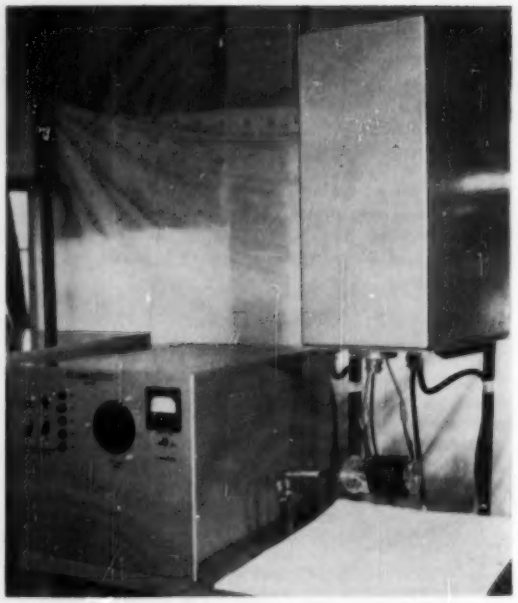


Fig. 4. The lamp and power supply.

$$\frac{1}{F} = \frac{1}{u} + \frac{1}{v}$$

Since $m = v/u$ or $u = v/m$, it follows that $v = F(m + 1)$ by simple algebra. v however equals kD;

$$v = kD$$

or

$$kD = F(m + 1)$$

and

$$= \frac{F}{D} = \frac{k}{m + 1}$$

Thus, as the magnification becomes great the f number becomes small. In fact, for small sources it may be required to be lower than possible to obtain with normal lens design. For instance, a 16mm motion-picture projector requires a light source of about $\frac{1}{4}$ in. A 35mm motion-picture film printer requires a $\frac{5}{16}$-in. source. Sources any larger than these are simply a waste of power; anything smaller requires lenses that cannot be produced. Thus in all those applications where a narrow pencil of light rays is employed, there is need for a bright, small source (but larger than a particular minimum).

It should be added that uniformity and stability are of particular importance in the above situation. This can be realized immediately from the fact that extra diffusion or other optical tricks, all of which lose light, must be used if the light source varies in space or in time. In fact, losses by a factor of 4:1 are not uncommon in printers due to the need for diffusion filters for incandescent lamps.

The RF Lamp

Since it was established that a bright, uniform, continuous source was desired, it was decided to throw all caution to the winds and design a lamp which was as close to the ideal as possible, even though the power supply might be bulky or the cost rather high. The obvious way to accomplish this would be to heat somehow to a very high temperature a solid disk made of highly refractory material. Such a light source would be bright if it were heated to a high enough temperature; it would be uniform if a proper method of heating could be employed; and it would be stable if the refractory material were to remain solid.

The highest melting materials available today are the carbides of zirconium, tantalum and hafnium. Fortunately these materials are also electrically conductive and therefore make electrical heating possible. In fact, some early work had been done by Cooper and Pironi on incandescent lamps made with tantalum carbide filaments. Since filaments could not provide a uniform source and a solid source could not be heated by direct conduction, it was decided to try induction heating of a disk by radio-frequency power.

The first attempts at building such a lamp were successful in arriving at a lamp that could give brightnesses above that of tungsten incandescent, but the life was short and the power supply was large beyond all reason. After much effort was spent toward preprocessing the material and improving the radio-frequency efficiency, a practical lamp

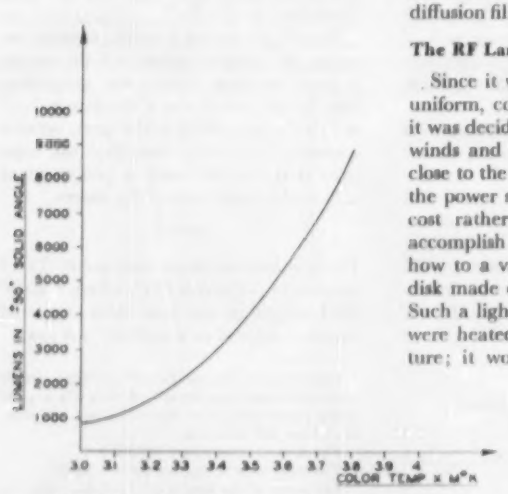


Fig. 5. Luminous flux vs. color temperature.

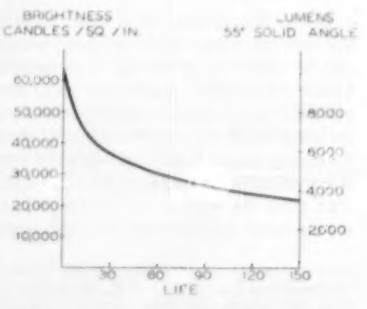


Fig. 6. Lamp life vs. lumen output and brightness.

resulted. The lamp, Sylvania Type AN20, involved a $\frac{5}{16}$-in. tantalum carbide disk supported by a zirconium oxide rod. Concentration of the r-f field was accomplished by means of a split copper cylinder inside the glass envelope. A copper coil provided a means of coupling the r-f oscillator to the copper cylinder. Figure 3 shows schematically the lamp and power supply shown in Fig. 4.

Performance of the Lamp

Most incandescent lamps are rated in terms of the total lumens given out in a 360° solid angle. In a system that involves optics, however, the amount of light that is picked up by the condenser lens is of more interest. Figure 5 shows the number of lumens in a plus and minus 50° solid angle for various color temperatures of operation. Figure 6 illustrates graphically the manner in which life varies with the lumen output and the brightness. A 750-w biplane projection lamp has an average brightness of about 21,000 candles/sq in. It can easily be seen from Fig. 6, therefore, that both longer life and higher brightness can be obtained from the r-f lamp than from a projection lamp.

Applications

Optical Printing: The r-f lamp was tried in an optical 35mm film printer. It was found that the uniformity of the source allowed the elimination of a diffusion filter that was required when a projection lamp was used. The prints showed no evidence of harshness, and printing speeds of four times normal were made possible. The operating point was about 3500 K and, therefore, there was a little more relative exposure in the blue than in the red. The color of the lamp was constant with respect to life since there was no blackening of the bulb. It was necessary, however, to increase the power into the lamp as it aged. In fact, the end of life was determined by the power capabilities of the power supply rather than by fall-off of light output from the lamp. Work is now under way on an automatic light output control that will keep the power supply adjusted to that the level of light will remain the same throughout the life of the lamp.

Projection: The lamp was tried in a 16mm projector, and 1800 screen lumens were obtained at the 3700 K operating point. 800 screen lumens is about the maximum that can be obtained with a projection lamp. The uniformity across the screen was within 10% and nonuniformity was due to the optics rather than the light source. The uniformity of the source itself is about 3%. See Fig. 7 for a photograph of an image of the source.

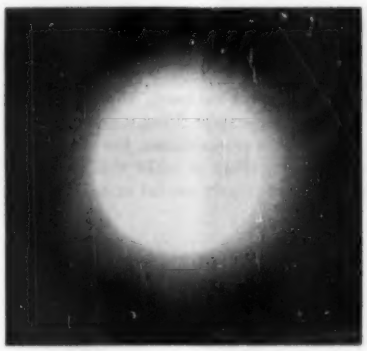


Fig. 7. An image of the source.

Other Applications

Several other applications that could take advantage of a bright, uniform, stable light source might be:

1. Microscopy
2. Contour Projectors
3. Computer Read-Outs
4. Search Lights
5. Spotlights for Studio Lighting
6. Microfilm Printing

Summary

There seems to be a growing need for a bright, uniform source of small but finite size. A lamp based on the induction-heating principle was designed to fill this need. The lamp is capable of being operated up to 50,000 candles/sq in. and the life seems reasonable. Actual tests in a printer and projector showed improved performance over projection lamps.

We wish to acknowledge the help of the Motion Picture Research Council in the early development and evaluation of r-f lamps.

Discussion

C. J. Staud (*Eastman Kodak Co.*): In the optical printer did you find any difficulty with scratches printing rather badly from the negative? And, is there enough stray radiation from this source to interfere with a television picture?

Mr. Peek: The power supplies, which are induction heating units, have been tested according to recent FCC requirements. The installation should be well shielded in order to guarantee meeting these, but the power supply itself doesn't need it.

On the question of scratches: The source is uniform enough so that actually we can image it at the film gate or close to it. If that were done, scratches might show up. I'm sure though, that if it's optimized for the optics concerned—that is, with the most light through and no overlap or underlap of any lenses—the image will occur somewhere in the objective lens, and the scratches won't show up any worse than they would with a projection lamp. With a projection lamp we have to end up with a uniform source anyway, either through diffusion or defocusing.

George T. Howard (*General Electric*): Can you describe more fully the end of life of this lamp? And, what is the power supplied to the source?

Mr. Peek: As far as the end of life goes, it's not like any other lamp. We don't get any short-term failures. The RF lamp gradually requires more and more RF power to keep it at the same light output until finally we reach the limit of the power supply. We worked out an automatic control, experimentally, that keeps increasing the power into the light to maintain a constant brightness. This also makes up for line-voltage fluctuations. What happens is that material gradually forms which is cool and does not show up on any projected image of it between the tantalum carbide and the concentrator and conducts some of the heat away, so you have to make up for the heat loss by increasing the power input into the material. With 1$\frac{1}{2}$ kw for that point at end of life of RF power, it draws somewhere around 3 kw from the line.

Paul Klingenstein (*Kling Photos*): How is the color temperature affected by the varying amount of power that you put in?

Mr. Peek: Actually we're putting in more power to bring it back to its original color temperature. The color temperature and the light output change together in an ordinary incandescent. As tungsten vaporizes off onto the bulb, the color temperature changes more rapidly than the total light output. Since we don't have any vaporized film on the bulb the color temperature and the brightness go down together, but if we bring the power back up either by turning a knob or using automatic control, there is no change in color temperature.

Robert A. Haines (*Far East Army Air Force Motion Picture Service*): A concentrated light source for 16mm projectors is of great interest now when several producers propose to introduce 16mm CinemaScope; however it doesn't look as though a source which must be water-cooled would be practical for the usual 16mm projector, certainly not for the military services. I presume your water cooling is necessary to keep the envelope from softening. Is that correct?

Mr. Peek: It's really to keep the copper concentrater from melting. As to the hope of getting rid of water, we have good prospects. Right now we're trying to get a reaction from the actual users.

Mr. Haines: If you can develop a source of the lumens figure you mention that will be compact and fit into a practical-sized 16mm projector, there will be a large demand for it.

Mr. Peek: I think we can get rid of the water cooling a lot sooner than we can get rid of the big power supply.

Frank Herrnfeld (*Herrnfeld Engineering Co.*): How will raising the color temperature affect printing of color film?

Mr. Peek: Actually very little. It just means using another kind of filter. It isn't like going to a noncontinuous spectrum kind of lamp, nor is it anywhere near as big a change as going to xenon, for example.

Mr. Herrnfeld: But if you're reducing the color temperature with these filters, don't you also bring it down to identically the same brightness as if you had a tungsten at 3000 K?

Mr. Peek: No, you don't. The brightness goes up as the fourth power of the physical temperature. If you took a light source composed of a solid material and kept increasing its temperature, you'd get more and more brightness in the fourth power of the temperature. Then, if you correct its color temperature by putting filters in, you don't go back to where you started from, because color temperature is only a measure of its color, it isn't a measure of its brightness. If we said "intrinsic temperature," that would be a different thing. The relationship between the color temperature and the intrinsic temperature changes as you use the filters, so you actually end up gaining.

Polyester Photographic Film Base

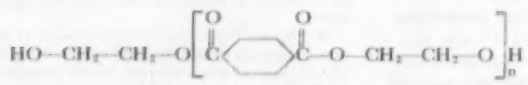
By DEANE R. WHITE, CHARLES J. GASS, EMERY MESCHTER and WILTON R. HOLM

Properties of "Cronar" polyester photographic film base are outlined. The utility and importance of these characteristics in the use of photographic films, especially cine films, are discussed. Optical clarity, high wear and tear resistance, low moisture sensitivity and relatively high stiffness modulus combine to make this base an excellent one for general use and one which is particularly useful in certain demanding applications.

THIS PAPER describes a new base for use in photographic films. It is currently being introduced to the trade under the name "Cronar" polyester photographic film base. This base embodies a new balance of important physical and chemical properties in the critical areas of strength, optical quality, wear resistance, chemical and dimensional stability. This balance of properties makes the base particularly well suited to the needs of the motion-picture industry.

Manufacture

The basic raw materials which come to the film base plant are dimethyl terephthalate and ethylene glycol. The first step in the manufacturing process removes the methyl groups from the dimethyl terephthalate and substitutes units from the glycol. This is followed by further reaction under reduced pressure and elevated temperature in the presence of suitable catalysts which regenerates some glycol and joins the remaining material into relatively long molecular chains of the general formula:



As the chains increase in length, the viscosity of the material increases. At the completion of the reaction, the polymer prepared for film base manufacture has a viscosity in the molten form which is comparable to the room temperature viscosity of heavy corn syrup.

The molten polymer is extruded into a thin sheet and cooled. At this point the chemical reactions are complete, but optimum physical properties are produced in the film by a subsequent drawing operation.

Substrata or anchoring layers are applied as required to secure the adhesion of photographic emulsions to the base. The problem here is, of course, a counterpart of that encountered in older methods of film manufacture in anchoring hydrophilic gelatin to a hydrophobic base.

Presented on October 3, 1955, at the Society's Convention at Lake Placid, N.Y., by Deane R. White (who read the paper), Charles J. Gass, Emery Meschter and Wilton R. Holm, Photo Products Dept., E. I. du Pont de Nemours & Co., Inc., Parlin, N.J.
(This paper was received on October 5, 1955.)

Properties

The product, Cronar polyester photographic film base, as it comes from the base manufacturing unit, is a strong, tough, clear plastic film, with good dimensional stability during normal changes of room temperature and humidity and is relatively inert to common solvents and chemicals.

Strength and toughness, both fresh and aged, are shown in Table I. Young's Modulus, 550,000 psi for polyester, remains essentially unchanged with aging either three years at room conditions or 144 hr at 100 C. The modulus for triacetate was less, about 450,000 psi. Tensile strength, both as measured at the yield point and at the break point, shows little change with age and is higher for polyester than for triacetate. The retention of relatively high per cent elongation at break, tear strength and folding endurance are all substantial indications of the initial good properties and aging stability of polyester base.

The clarity of the polyester base is good. The transmission curve, shown in Fig. 1, is even and high in the visible region of the spectrum. In the ultraviolet a sharp cutoff occurs at about 3150 A.

The performance of Cronar base is outstanding by present-day standards in its insensitivity to humidity. This is shown by the first line of Table II by a coefficient of expansion over a humidity range, 20 to 70%, in which the relationship is quite linear. If the conditions are extended toward complete saturation, there is a departure from linearity and the behavior of the polyester base is even more outstanding as shown in the table's second line called "swelling." The ratio of the swelling of the triacetate base to that of the polyester base is much greater than the ratio of the coefficients shown in the line above for a more limited change in relative humidity. Moisture pickup from dry conditions to various degrees of wetness is shown by the water absorption figures of the table. Note that these are weight changes, not dimensional changes, and are much smaller for the polyester base than the triacetate. The coefficient of thermal expansion, last line of Table II, shows Cronar base to be quite normal in this characteristic.

Another aspect of dimensional stability is stability during prolonged storage. Film bases of the past have predominantly shown a shrinkage on long-term aging, the rapidity and magnitude of which depended on storage conditions. This permanent shrinkage has been ascribed to loss of residual solvents or plasticizers used in the cellulose ester supports. This new base is made without solvents, contains no plasticizer, and shows essentially no shrinkage with time under normal room temperature storage conditions. In fact, this is true at elevated temperatures even somewhat in excess of 100 C. In the photographic field, this far exceeds any conditions of long-term storage, though temperatures of this magnitude may be encountered for short periods under projection conditions.

Chemically, polyester photographic film base is inert to the action of many reagents and solvents. At room temperature it is unaffected by aldehydes, esters, ethers, alcohols, aromatic and aliphatic hydrocarbons and chlorinated hydrocarbons. At temperatures above 100 C it

Table I. Representative Physical Properties of Film Base.

		4-mil polyester base		
	5.5-mil cellulose triacetate	Fresh	After 3-yr room storage	After 144 hr at 100 C
Young's Modulus, psi, (1)	450,000	550,000	550,000	550,000
Tensile strength, psi, (2)—Yield . .	11,500	13,500	14,000	14,500
Break . .	11,500	19,000	20,000	20,000
Elongation at break, %, (2) . . .	5	65	70	75
Tear strength, g, (3)	65	180	180	180
Fold endurance, cycles, (4)	40	Over 15,000	35,000	Not run

Notes: (1) Determined by ASTM method D747-48T at 45% R.H.
(2) Determined by a modification of ASTM method D882-49T at 45% R.H., Method B, in which the jaws on the Instron Tester were faced with emery cloth and a cross-head speed of 1 in./min and a sample length of 1 in. were used.
(3) Determined by ASTM method D689-42T at 45% R.H.
(4) Determined by ASTM method D643-41T at 45% R.H., Method B.

can be dissolved with trifluoro-acetic acid, and some phenols, aromatic alcohols and halogenated hydrocarbons. Glacial acetic acid has little effect on polyester photographic film base. Strong bases attack it quite slowly at room temperature. Attack of alkalis at elevated temperatures is more rapid but the action in general can still be considered slow.

Most of the data just given were descriptive of the base at normal room temperatures. One feature which makes polyester base particularly useful under some less usual conditions is its flexibility at low temperatures. Of course, the behavior of finished film depends on the emulsion coating as well as on the base. In low-temperature tests a coated film made with polyester base was flexed 560 times at −40 C before breaking, while the corresponding triacetate stock was brittle and shattered during the first bend.

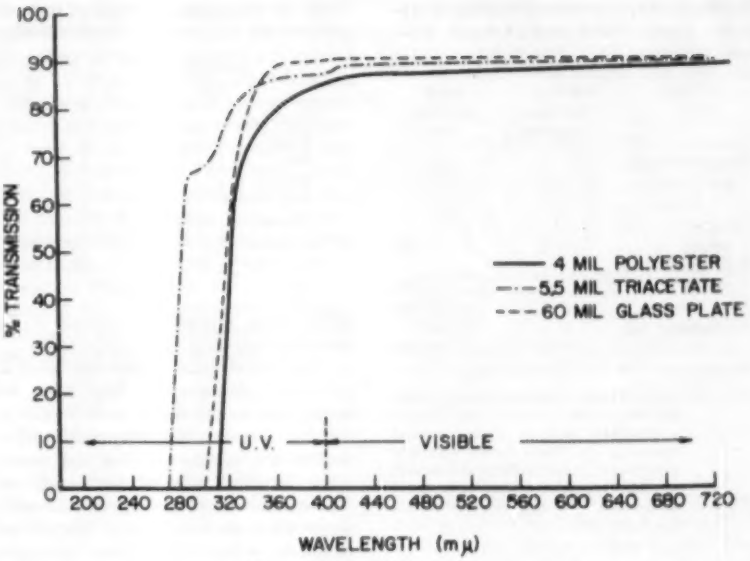


Fig. 1. Spectral transmission.

Splicing

A year ago a paper was presented to the Society on a method of splicing film using a perforated tape of Mylar polyester film base coated with pressure sensitive adhesive.* It was pointed out at that time that the work was part of a study of splicing undertaken in connection with the Cronar base development program. Interest in this splicing method has continued in its own right; 35mm splicers have been designed and delivery of production models is anticipated soon; 16mm units are also nearing completion of production design. These units are fully universal in that they will make splicers without regard to the chemical nature of the two films joined.

Alternative techniques for making the splices needed in cine laboratories are in final stages of development and will, of course, be introduced prior to full commercialization. The chemical inertness of polyester base limits the choice of solvents that can be used to secure a bond of the type commonly made with cellulose ester films. In fact, the best splices made with equipment originally designed for cement splicing of films have been made with a cement formulation in which ordinary solvent action appears to play little part.

Film Thickness

Very early in the development program it became apparent that, because of the outstanding strength and durability of polyester base, it might be feasible to reduce the thickness of motion-picture film support significantly below the 5.5-mil standard thickness used for cellulose triacetate.

Representatives of several motion-picture companies and laboratories, both on the East and West Coasts, were consulted as to the desirability of reducing the thickness of motion-picture film. The consensus was that a significant reduction in film thickness would be desirable since it would result in such economic and film-handling advantages as more footage per reel, fewer reels and containers, and less shipping weight per picture. Early scouting trials and study of the comparative physical properties of polyester base and cellulose ester bases led to the conclusion that a 4-mil polyester base had a high probability of showing satisfactory performance and therefore should receive thorough trade evaluation. The evaluation program is well along, though not yet complete. All of the data received to date indicate that satisfactory film structures can be made with 4-mil base. Actually, in the 16mm field still thinner base appears possible, and it may turn out that further gains in footage per reel can be made. This possibility has special significance in the television field.

Physical Properties of Films

The physical properties of polyester base safety motion-picture films differ in a number of respects from those of standard films since the primary characteristics of the base, toughness, flexibility and dimensional stability, are largely retained in the finished film. Table III shows how 35mm release positives compare in strength, folding endurance, tear strength and projection life. Total film strengths are approximately the same. The film with the polyester base is outstandingly superior in folding endurance, tear strength and projection life.

Dimensional Stability

The effect of photographic processing on film dimensions for cellulose triacetate and polyester photographic film bases coated with fine-grain release positive emulsion is shown in Table IV. The per cent changes in length are relative to the

Table II. Response to Humidity and Temperature Changes of Film Base.

	Cellulose triacetate	Polyester base
Coefficient of humidity expansion, in/in/1% R.H. change (over the range 20% R.H. – 70% R.H. – 70 F)	4.1×10^{-6}	1.0×10^{-6}
Swelling, 40–100% R.H., %, (5)	0.55	0.08
Water absorption, %, (6): 0–40% R.H.	1.8	0.35
0–70% R.H.	2.4	0.60
0–Water soak	4.5	0.80
Coefficient of thermal expansion, in/in/°F	2.3×10^{-6}	2.0×10^{-6}

Notes: (5) % Swelling $= \frac{W - F}{O} \times 100$

Where O = original length (10 in.) in equilibrium at 40% R.H., W = length after immersion in water at 25 C for 24 hr, and F = final length in equilibrium at 40% R.H.

(6) % moisture gain at equilibrium after being dried over $CaCl_2$.

*V. C. Chambers and W. R. Holm, "A method for splicing motion-picture film," *Jour. SMPTE, 64:* 5–8, Jan. 1955.

Table III. Representative Physical Properties 35mm Perforated Release Positive.

	5.5-mil cellulose triacetate	4-mil polyester base
Tensile strength, psi, Yield	75	70
Break	75	80
Elongation at break, %	5	45
Fold endurance, cycles	40	Over 15,000
Tear strength, g	65	180
Projection life, cycles, (1)	1150	Over 3,000

Note: (1) Projection life refers to number of times release positive film can be run through a standard projector under normal operating conditions before complete perforation failure. Polyester showed virtually no sign of wear after 3,000 projections. All tests were run using a 6-ft loop of film.

length of the film as originally in equilibrium with 40% R.H.

The much smaller change in length of polyester based film during processing may necessitate adjustment of some present developing machines but may simplify future machine design.

As would be expected from the data of Table IV, emulsion-coated polyester films show very small dimensional changes as a result of relative humidity variation. Table V shows the per cent changes in length relative to the length of the film as originally in equilibrium with 50% R.H.

Table V. Change in Length of Release Positive Related to Dimension at 50% R.H.

Relative humidity, %	5.5-mil cellulose triacetate	4-mil polyester base
20	−0.11%	−0.07%
50	0.00	0.00
70	+0.09	+0.04
100	+0.31	+0.07

Table VI shows processed film shrinkage caused by aging for six months under two different conditions of storage. The nonuniform ambient conditions tend to make the film containers breathe and represent a more severe aging condition than uniform conditions of the same average value.

Table VI. Six Months' Shrinkage of Processed Release Positive Film.

Storage conditions	5.5-mil cellulose triacetate	4-mil polyester base
40% R.H., 70 F	0.02%	0.00%
Nonuniform temperature and R.H.	0.09	0.05

Table IV. Changes in Length of Release Positive During Processing.

Processing step	Time in solution	5.5-mil cellulose triacetate	4-mil polyester base
Develop	3¼ min	+0.10%	+0.015%
Rinse	½ min	+0.12	+0.015
Fix	10 min	+0.20	+0.025
Wash	15 min	+0.28	+0.03
Dry (100 F)	10 min	−0.05	+0.01
Condition (40% R.H.)	20 hr.	−0.01	+0.01

The low-shrinkage characteristics of polyester photographic film base are recognized in the selection of 0.1870 in. for the length pitch of positive films, and 0.1867 in. for negative and sound-recording films selected for evaluation. These values meet ASA specifications for fresh films on low shrink base. Good performance was obtained and we expect this good performance to continue as the film ages even in the absence of age shrinkage. Experience to date has confirmed this.

Film-Aging Characteristics

The chemical inertness of polyester base itself was mentioned previously. Less chemical interaction between emulsion and base has been evident than occurs with cellulose acetate bases typical of today's safety films. Elimination of reactions from the base is no cure-all for aging ills but is a favorable factor in obtaining desirable aging characteristics of finished films.

Burning Rate and Ignition Temperature

Flammability characteristics of polyester photographic films were determined using both the American Standards Association Method Z22.31-1946, and the Underwriters' Laboratory Method (U.L. Bulletin of Research No. 22). The results of these tests are shown in Table VII.

Cronar polyester safety films meet American Standard definition for motion-picture safety film Z22.31-1946. They are listed as slow burning under the Underwriters' Laboratories Re-examination Service, the fire hazard associated with them being slightly less than that of common newsprint in equivalent form and quantity.

Roll Sizes

As previously mentioned, evaluation of polyester motion-picture safety films has centered on films with a base thickness of 4 mils. The use of base of this thickness allows approximately 35% more footage to be packed in existing 1000-ft and 2000-ft film cans. This significantly reduces shipping weight and storage volume per foot of film, which, in turn, can result in economic advantages resulting from improved efficiency of production operations as well as lower shipping costs.

Table VIII compares 35mm release positive roll weights and roll diameters of different lengths of film wound on standard plastic cores. The diameters of 1000-ft and 2000-ft rolls on triacetate base are slightly greater than those of 1300-ft and 2600-ft polyester rolls respectively. The weights of these rolls of nearly equal diameters are about the same.

Practical Performance of Cronar Films

Several hundred thousand feet of polyester safety films of various types and polyester clear leader, all 4 mils thick, made in the pilot plant at Parlin, have been tested in East and West Coast Studios and laboratories. These tests have shown 4-mil polyester base able to perform in highly satisfactory fashion. The tests have included printing, processing, camera exposure and sound recording operations on both 35mm and 16mm films. They include standard motion-picture operations as well as certain special industrial applications in which film has not been able to perform satisfactorily in the past. Some of these applications have been made possible by the superior toughness and durability; others because of its excellent dimensional stability.

Table VII. Flammability of Positive Rawstock.

	5.5-mil cellulose triacetate	4-mil polyester base	Specification: "Safety" or "Slow Burning"
Underwriters' Laboratory Method			
Burning Time, sec	100	150	Over 65
Ignition Temp., C	475	525	...
ASA Burning Time, sec	Infinite	Infinite	Over 45

Motion Picture Research Council Tests

Several thousand feet of polyester film of various types, including camera negative, release positive, master positive, duplicate negative, variable-area and variable-density sound recording films, have been evaluated in Hollywood motion-picture studios and laboratories under the sponsorship of the Motion Picture Research Council. In no case did 4-mil films fail to perform satisfactorily in these tests.

Camera Negative: Tests of negative emulsions on 4-mil polyester base were arranged to determine problems or difficulties that might be encountered in production cameras.

Tests in standard and NC Mitchell cameras proved the complete absence of mechanical troubles attributable to the film material and thickness. Good steadiness and acceptably low camera noise were shown. High speed, up to four times normal, was included in these tests at the M-G-M and Republic studios without any difficulty. Adjustment of the pressure plate appeared to improve definition slightly, although tests made without such adjustments were judged equivalent in definition to standard negative film on 5.5-mil base.

From the results of the tests it was concluded that 4-mil base is entirely satisfactory in standard production and high-speed cameras. Adjustment of the pressure plate is advisable, although not mandatory.

It is expected that raw stock for more general test and evaluation will be available in the immediate future.

Printing and Processing Tests: The Motion Picture Research Council supervised tests at Consolidated Film Laboratories and General Film Laboratories to uncover possible problems or difficulties of printing and processing 35mm films on 4-mil polyester base.

These tests included common printing and developing operations as applied in the making of direct prints, master positives, duplicate negatives and second generation prints. Contact continuous, contact step and optical printers were used. All printing was performed without any adjustment of printer gates, etc., to compensate for differences in base thickness. All tests were duplicated with a corresponding triacetate film type of 5.5-mil base thickness as a reference.

The results of these tests were inspected by projection in each laboratory in the presence of personnel in charge of technical operation, and were finally projected for the members of the Laboratory Committee of the Motion Picture Research Council. The unanimous conclusion reached by the laboratory personnel, the Laboratory Committee members and the Research Council staff was that no difficulty should be encountered in the laboratory processing of 4-mil polyester based films, with the possible exception of minor adjustments of printer gates to compensate for base thickness differences. The Laboratory Committee accordingly agreed that additional similar tests in other member company laboratories could be dispensed with. Member companies include Allied Artists, Columbia Pictures Corp., Loew's Incorporated (M-G-M), Paramount Pictures Corp., RKO Radio Pictures, Inc., Republic Productions, Inc., 20th Century-Fox Film Corp., Universal Pictures Company, Inc., Walt Disney Productions and Warner Brothers Pictures, Inc.

Variable-Area Sound: Tests were made at RCA, Hollywood, to determine differences, if any, in variable-area sound recording characteristics between 4-mil polyester and standard 5.5-mil triacetate films. Optical system focus adjustment was changed when changing from one film to the other, due to the difference in film thickness. Test results indicated only minor differences in the recording characteristics of the two films.

Equipment used for recording the negatives included the following: PR-31 Recorder, MI-10235 Power Amplifier, and MI-10803 Modulated Carrier Oscillator. White light exposure was used throughout all tests. A PB-138 film phonograph was used for reproducing the cross-modulation test films. All film processing was done by Consolidated Film Industries.

Variable-Density Sound. One-thousand-cycle and 8000-cycle frequencies were recorded as variable-density tracks at the Samuel Goldwyn Studio Sound Recording Dept. on both 4-mil polyester and 5.5-mil triacetate. The recording was done on a Western Electric "D" specification machine with four to one objective lens and white light. The negative was then reproduced on a Western Electric 1251 re-recording machine.

Under these conditions the film with polyester base was out of focus an amount to reduce the volume output at 8000 cycles by 0.7 db in comparison with standard material on the full thickness triacetate base. This loss could be fully compensated by refocusing, but it was also observed that a compromise intermediate position could be selected which gave equal high-frequency response on both materials. At this point the loss is approximately 0.4 db greater than obtained with the optimum setting for either film. It is anticipated that most recorders would choose this intermediate setting and that it would be satisfactory for practical requirements of high-grade sound-recording work. If this judgment is correct the two films could be used interchangeably under these conditions.

Table VIII. Diameters and Weights of Rolls 35mm Release Positive.

Film length	5.5-mil cellulose triacetate	4-mil polyester base
	Roll diameter, in.	
800 ft	8.7	7.6
1000 ft	9.8	8.5
1300 ft	11.0	9.5
2000 ft	13.7	11.8
2600 ft	15.5	13.3
	Roll weight, lb	
800 ft	3.5	2.9
1000 ft	4.4	3.6
1300 ft	5.7	4.6
2000 ft	8.7	7.1
2600 ft	11.3	9.3

Kine Recording

Tests made at Du Mont TV, New York and at CBS-TV, Hollywood, using P824 low-contrast kine-recording positive film showed the film to behave excellently in several kine-recording cameras and in motion-picture film scanners. No problems are expected to be encountered in using the 4-mil based films, and the advantages of thinner films for kine recording are very definite.

Theatrical Evaluation

With the most helpful cooperation of Paramount Pictures Corp., several reels of the feature photoplay *The Country Girl* were printed on polyester fine-grain release-positive film. These were interspliced with sections printed on triacetate to give 2000-ft reels, half polyester and half triacetate, and were played in a number of theaters in the New York, Chicago, Minneapolis, New Orleans and Los Angeles exchange areas. Most of these reels were projected more than 300 times, while others varied from 25 to 200 projections. Except in one instance of equipment failure, there was not one case of film breakage of the Cronar base — not even in the leaders! No perforations broke out, and no repair splices had to be made on the polyester reels, although the leaders on the triacetate control reels had to be replaced at least twice before 300 runs had been accumulated. The cellulose triacetate sections of the reels averaged about seven splices per reel during 300 runs.

The question has been asked repeatedly in connection with films so tough and so durable as polyester films: "What happens to equipment if the film should jam?" This question was answered dramatically with respect to a projection machine in the one case of film breakage which occurred during *The Country Girl* evaluation. When the take-up magazine belt broke, the Cronar film eventually wound around the intermittent sprocket and jammed tightly enough to stall the machine. After cut-

ting the film out of the projector, however, the belt was replaced, the film rethreaded, and the projector worked perfectly. No sprocket teeth were damaged and no shafts were bent.

On the debit side, this evaluation did succeed in pointing up a tendency for the 4-mil base to have focus difficulty in some projectors. Additional high-intensity projection studies are now in progress, and it is expected that additional evaluation tests in the near future will demonstrate freedom from focus troubles.

The polyester film was enthusiastically received by exchange managers, not only because it offered reduced shipping costs, but because of the greater perforation strength. Broken perforations cause many prints to lose playing time until a replacement section can be secured, and additional expenses are required to locate and borrow interim prints in order to meet booking dates.

Almost without exception, projectionists, too, were enthusiastic about polyester films, not only for the added convenience of more footage per reel and fewer changeovers per show, but because of the new measure of security against film breakage during projection which polyester offers to the man in the booth.

Summary

In summary, we have described an improved film base of new chemical composition. Its chemical and physical characteristics offer better performance combined with substantial savings in weight and space. Extensive testing and evaluation lead us to believe that its introduction will mark a step forward in motion-picture technology, with benefits accruing to all concerned.

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Discussion

J. I. Crabtree (*Eastman Kodak Co.*): To what extent is the ester hydrolized when subjected to temperatures of about 90° and 90% relative humidity? Can you venture a guess as to the probable archival life of this material in the tropics?

Dr. White: This product as a composition of matter has not been in existence for many years. We in the Du Pont Co. have been working with it longer than anyone else; but our years of experience are still relatively few as compared to our backlog of 40 to 50 years with cellulosic bases. We have run a great many tests under a great variety of conditions, and the stability we have found gives us every indication that over a long time this material will prove to be unusually stable and eminently suitable for archival purposes. This is a young child. We are confident it will grow up well.

George Lewin (*Signal Corps Pictorial Center*): Do you have any data with respect to its behavior with magnetic stripes, either the laminated or the adhesion type, especially with respect to shrinkage?

Dr. White: Both types of magnetic stripes have been applied successfully. I have no data with me.

Dr. Edwin C. Fritts (*Eastman Kodak Co.*): Did you state the index of refraction of this material?

Dr. White: I did not state it in the paper. The index of refraction is somewhat higher than cellulose triacetate (1.64).

Paul Klingenstein (*Kling Photo*): What about the electrostatic qualities of this film base?

Dr. White: If no steps are taken to improve them, they are bad. However, an antistatic treatment is applied as a part of the manufacturing process. This brings the static properties of "Cronar" base within practical requirements.

Emmett Salzberg (*Circle Film Laboratories*): Would you comment on the suitability of this material as a cover plate for 35mm cardboard-mounted transparencies? The shatter-proof feature would seem to be an advantage, compared to the glass that is now used.

Dr. White: That is an area in which I have no experience. The temperature factors involved in slide work are so different from the balances that exist in motion picture work that I cannot give you an answer to your question at this time.

Gio Gagliardi (*Stanley Warner Theatres*): Do optical sound systems require refocusing for this particular thickness of film?

Dr. White: Most optical recording systems have critical focus features which take into account the thickness of the sound-recording film so that the emulsion will travel through the recording device exactly in the focal plane of the recorder optics. When you have a 4-mil instead of a 5½-mil film thickness, this difference in thickness must be taken into account in order to obtain the best focus.

Mr. Gagliardi: Does that create a great difference? Wasn't it only 0.6 db at 8 kc, or what was it?

Dr. White: I referred to a compromise setting for variable density recording which was between the optimum focus setting for "Cronar" and that for triacetate, and gave only 0.4 db difference from either optimum setting. We have no comparable data from our variable area sound recording tests.

Anon: What tests have been made with regard to the hardness or scratchability of this material?

Dr. White: Tests have been made with regard to scratchability; any differences between "Cronar" and triacetate are negligible, both by laboratory tests and by actual projection tests in the field. I might add that the scratch resistance of "Cronar" films depends not only upon the base material itself, but also upon the treatments applied as antistatics.

Norman Lipton (*Popular Photography*): Regarding the flammability characteristics, is "Cronar" substantially or slightly more flammable than triacetate; and if so, is this a function of the thickness or of the chemical constitution of the base?

Dr. White: The behavior of the two film bases is slightly different, depending upon test conditions. In general, the thinner a material is, the easier it will burn for obvious reasons. The fact is that 4-mil "Cronar" meets the same safety film requirements of the ASA and the Underwriters' Laboratories as does 5½-mil triacetate. I don't believe I know how to make any finer distinctions than that.

George G. Tschume (*Bausch & Lomb Optical Co.*): Have any tests been made in aerial photography —that is photogrammetry?

Dr. White: They have been rather limited. They have been particularly interesting, however, because of the dimensional stability of "Cronar," and its flexibility under low temperature conditions. I believe these are considerable advantages under some operational conditions.

Henry Roger (*Rolab Studios*): Have tests ever been made on a laminated film? This means that you use a very thin base to put the emulsion on, and after printing you laminate another very thin layer of base upon it for greater durability.

Dr. White: We have made some tests of that sort on short lengths of film. They were very interesting, but we have not thought of them as commercially useful at present.

Mr. Van Niman (*Bureau of Ships*): Is there to be any basic difference in cost of this material, assuming ultimately corresponding production quantities?

Dr. White: It is expected that prices will be competitive.

E. W. Hamilton (*Trans-Canada Films, Vancouver*): Do you recommend any particular antistatic treatment for this film?

Dr. White: We are building static-reducing materials into the film, and we do not expect that it will be necessary for users to be concerned with this. If your question is "Have we published data on this?," the answer is no. If your question is, "Are such data available?," the answer is of course yes.

Processing Anscochrome Motion-Picture Films for Industrial and Scientific Applications

By JOHN L. FORREST

Anscochrome is a new 16mm reversal motion-picture film with an exposure index of 32. The film can be processed by the regular Ansco color process in the field or in the laboratories of the manufacturer. Higher speeds can be secured for scientific and industrial applications at a sacrifice of fineness of grain and color balance by modifying the process. The processing procedure is described.

REVERSAL-TYPE color films for motion-picture work have been on the market for many years. Such films in 16mm and 8mm widths are best known for their prominence in the amateur color field. In recent years, improvements in resolution and grain, combined with the lower cost of 8mm film, have channeled much of the amateur market to 8mm film and advanced 16mm film into the professional category where it is used extensively for commercial, educational and advertising purposes.

While the negative-positive system has been generally adopted for 35mm professional motion pictures, the advantages of the reversal process in grain and definition have enabled it to hold its own in the production of commercial 16mm positives. It also offers unique advantages for scientific and industrial work where the film is used primarily for investigational and information-gathering purposes. Here a single print is often sufficient and the reversal process yields this at minimum time and cost.

Presented on October 5, 1955, at the Society's Convention at Lake Placid, N.Y., by John L. Forrest, Motion Picture Development Laboratory, Ansco, Binghamton, N.Y.
(This paper was received on October 18, 1955.)

Description of Anscochrome

To meet the need for a higher-speed reversible color film, Anscochrome was introduced in the spring of 1955. This film is an integral tripack reversal film in classical formation (Fig. 1).[1] The top layer is sensitive to blue and gives a yellow image. A yellow filter which disappears in processing is placed between the top and middle layers to prevent blue light from recording in the middle layer. The middle layer records green light and yields the magenta image. The bottom layer records red light and gives a cyan image. A thin colloidal silver layer under the emulsion layers provides halation protection.

The film can be processed by the regular Ansco color process[2] by the user, or in the Ansco processing laboratories.

Two types of Anscochrome are available: one balanced for use in average daylight conditions, and the other for tungsten (floodlight) illumination.

The processing of reversal film has always been rather critical because only within a narrow range of speed did all the layers respond the same to processing. Slight changes outside of these narrow limits caused the responses of the layers to diverge, resulting in a shift in color balance throughout the exposure scale.[3]

Anscochrome differs from previous reversal color films in that the three emulsion layers respond alike to changes in developing time over a wide range. This makes it possible to adjust processing conditions to the exposure, as in black-and-white work.

Characteristics

Daylight-type Anscochrome is balanced for use under average daylight conditions (about 6000 K). For daylight exposure, no filter is required. For exposure under tungsten illumination, a #10 conversion filter should be used. This combination reduces the speed to about E.I. 8 and is ordinarily not recommended because of speed loss.

The tungsten type is balanced for use with photoflood illumination (about 3400 K). For use in daylight, a #11 conversion filter is required. (This makes no significant change in the effective speed.)

The dyes produced in both types of film are similar (Fig. 2). They are more brilliant than those produced in Ansco color film, and the red and blue color reproduction has been improved.

Anscochrome is somewhat softer in

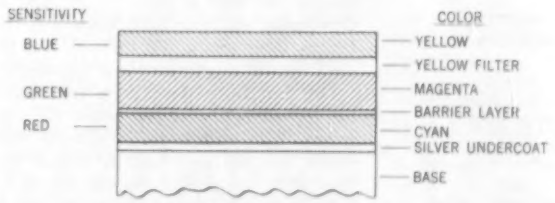


Fig. 1. Anscochrome layer arrangement.

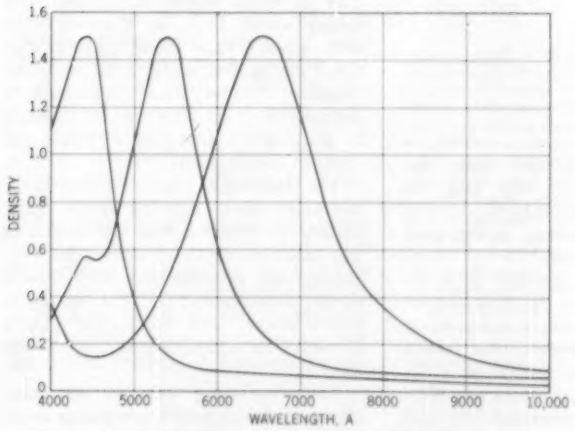


Fig. 2. Absorption of dyes of Anscochrome.

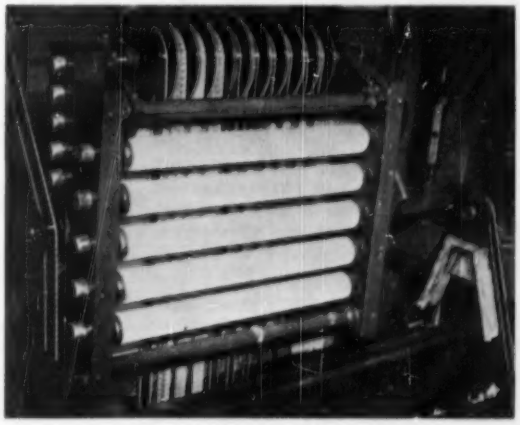


Fig. 3. Equipment for obtaining the second exposure.

Processing Formula for Anscochrome for 16mm Motion-Picture Film.

	First Developer — 502A-3		502A Replenisher	
	Metric	U.S. Liquid	Metric	U.S. Liquid
Water	800 ml	100 fl oz	800 ml	100 fl oz
Calgon	1 g	58 grains	1 g	58 grains
Metol	3 g	175 grains	3.5 g	204 grains
Sodium sulfite (dry)	50 g	6½ oz	52 g	6¾ oz
Hydroquinone	6 g	350 grains	8.5 g	1 oz, 58 grains
Sodium carbonate (mono)	40 g	5⅓ oz	45 g	6 oz
Sodium thiocyanate	2 g	117 grains	2.3 g	134 grains
Potassium bromide	2 g	117 grains	—	—
0.1% potassium iodide solution	6 ml	1 oz	—	—
Water to make	1 l	1 gal	1 l	1 gal
	Sp gr = 1.084			
	Shortstop — 859-B		858 Replenisher	
Water	800 ml	100 fl oz	800 ml	100 fl oz
Acetic acid (glacial)	3 ml	½ fl oz	10 ml	1¼ fl oz
Sodium acetate	30 g	4 oz	20 g	2⅔ oz
Water to make	1 l	1 gal	1 l	1 gal
	pH = 5.3 ± 0.2		pH = 5.0 ± 0.2	
	Hardener — 901			
Water	800 ml	100 fl oz	Replenish with same, then discard after one week.	
Potassium chrome alum	30 g	4 oz		
Water to make	1 l	1 gal		
	pH = 3.2 ± 0.1		Sp gr = 1.018	
	Color Developer — 607		607 Replenisher	
Water	800 ml	100 fl oz	800 ml	100 fl oz
Calgon	1 g	58 grains	1 g	58 grains
Sodium sulfite	5 g	292 grains	5.6 g	327 grains
S 5	5 g	292 grains	7.5 g	1 oz
Sodium carbonate	120 g	16 oz	135 g	18 oz
DA 3	2.8 g	162 grains	3.2 g	187 grains
Potassium bromide	1 g	58 grains	0.6 g	35 grains
Water to make	1 l	1 gal	1 l	1 gal
	Sp gr = 1.105			
	Bleach 716-1, with double ferro-ferri content for machine operation			
Water	800 ml	100 fl oz		
Potassium ferricyanide	100 g	13⅓ oz		
Potassium ferrocyanide $3H_2O$	10 g	2½ oz		
Sodium bromide	15 g	2 oz		
Disodium phosphate	11 g	1½ oz		
Citric acid	8 g	1 oz		
Formalin (37%–40%)	15 ml	2 fl oz		
Water to make	1 l	1 gal		
	pH = 4.7 ± 0.2		Sp gr = 1.078	
	Fixer — 800-B			
Water	800 ml	100 fl oz		
Sodium thiosulfate	200 g	26⅔ oz		
Sodium sulfite	5 g	292 grains		
Boric acid	4 g	233 grains		
Borax	3 g	175 grains		
Water to make	1 l	1 gal		
	pH = 8.0 ± 0.1		Sp gr = 1.110	

gradation than Ansco color and has more exposure latitude. The exposure latitude depends to a considerable degree on the type of subject and its brightness range. For average subjects, the latitude is considered to be ±½ stop. Within this range, the film retains full scale with good detail in highlight and open shadows; this lends it to satisfactory duplication on Ansco duplicating film Type 238.

The stability of the emulsion is similar to Ansco color and carries a one-year dating for storage at room temperature in temperate zones. As is the case with all color films, the enemies of stability are heat and humidity, and for climates of high humidity and high temperature, refrigerated storage is recommended.

The latent image stability is better in Anscochrome than in Ansco color reversible color film, but it is not equal to that of black-and-white film. As a general rule, the film should be processed as soon after exposure as possible.

Anscochrome is processed by the regular Ansco color process as outlined in Table I. The process consists of 13 steps including washes. The developing times in the first and color developer are adjusted for the exposure index used to expose the material. Normally, the film is processed to correspond to E.I. 32.

When processing for higher speeds, the developing time both in first developer and color developer is increased as shown in Table I. This prolonged time may not be obtainable on some developing machines. Similar results can be obtained by increasing the temperature of the first developer (step 1) from 68 F to 75 F, and adjusting the first developing time as indicated. The temperature of the color developer and other solutions need not be increased but should remain at 68 F.

The second exposure (processing step 4) can be accomplished simultaneously with the wash after hardener. In combining wash and the exposure, the top bank of rollers is raised out of the tank to accomplish wash and second exposure simultaneously. The method of obtaining the second exposure is shown in Fig. 3, and either tungsten or white fluorescent lamps can be used. Fluorescent lamps are preferred because they provide even illumination with little heat.

Agitation in Processing

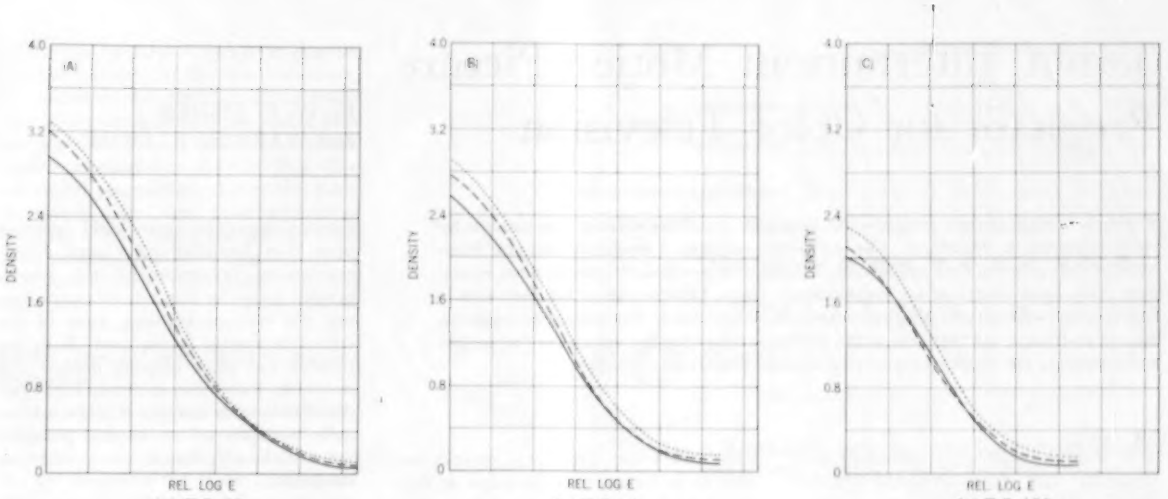
Agitation should be provided in the first developer (step 1), the short stop (step 2), color developer (step 5), and the shortstop after color developer (step 6).

In the developers, agitation can be supplied by submerged jets directed toward the film at close range. On a developing machine with loops 3 ft on center, three sets of jets on each side of the loop will supply adequate agitation.

On the Ansco developing machines, the top jet is placed just below the top rollers. The middle jet is midway between the top and bottom rollers. At this point, the film is backed up by a large rubber-covered roller. The third jet is placed near the bottom rollers. The jet tubes consist of stainless steel tubing about 1 in. in diameter with slots opposite each strand of film. The tubes are spaced about ½ in. from the emulsion. Under these conditions, a pressure of 6 oz above static pressure in the tank provides good agitation and uniform development.

The shortstops after first and color developer can be agitated by air. Compressed air introduced at the bottom of the tank on the side where the film enters will prevent stratification and arrest development in the emulsion layers quickly and thoroughly. This is necessary for uniformity in the finished film.

The developing rate in all three layers of Anscochrome progresses more uniformly than in Ansco color. This



(a) E.I. 32 (b) E.I. 64 (c) E.I. 128

Figs. 4(a)-(c). Characteristic curves: ——— red; - - - - - - green; ..... blue.

characteristic makes it possible to process the material with the speed range of E.I. 16 to 64 with little shift in characteristic curve.

Ansco laboratories process the material to correspond to an E.I. of 32. Up to an E.I. 64, the curve conformity shows little change. Above 64, the film becomes progressively unbalanced but holds together fairly well for one more stop in speed up to E.I. 128. The best quality from the standpoint of granularity occurs between E.I. 32 and 64 (Figs. 4A–4C).

At E.I. 64 and above, the increased speed is obtained at a sacrifice in fineness of grain, and a steepening of the characteristic curve results in a picture of higher contrast and increased granularity. This processing characteristic is referred to because the increase in speed of two stops makes it possible to make motion pictures in color under conditions previously considered impossible. The increase in speed is desirable for many scientific and industrial applications where information obtained is more important than photographic excellence. This is especially true in clinical photography, where the heat of the intense light has always presented a problem and made motion pictures impractical in many cases, particularly of microsection. The extra speed is highly desirable for missile-tracking, where information-gathering is of utmost importance.

The higher speed extends by several hours the filming day for football. This is particularly important in late fall and early winter when the light is poor.

We have found the film particularly useful for high-speed photography and for motion analysis. It has been possible to make records of fast-moving objects which heretofore could not be photographed.

Table I. Anscochrome Processing Procedure.

		E.I. 32	E.I. 64	E.I. 125
1. First developer	—	15 min at 68 F ± ¼	19 min at 68 F ± ¼	30 min at 68 F ± ¼ or 19 min at 75 F ± ¼
2. Rinse	15 sec			
Shortstop	3 min			
3. Hardener	3 min			
4. Wash and 2nd exposure	3 min			
5. Color developer	—	15 min at 68 F ± ¼	17 min at 68 F ± ¼	20 min at 68 F ± ¼
6. Rinse	15 sec			
Shortstop	3 min			
7. Hardener	3 min			
8. Wash	3 min			
9. Bleach	6 min			
10. Wash	3 min			
11. Fix	6 min			
12. Wash	6 min			
13. Dry				

References

1. E. J. Wall, *History of Three-Color Photography*, p. 2, American Photographic Publishing Co., Boston, 1925.
2. J. L. Forrest, "Machine processing of 16mm Ansco Color Film," *Jour. SMPE*, *45*: 313, Nov. 1945.
3. J. L. Tupper, "Practical aspects of reciprocity law failure," *Jour. SMPTE*, *60*: 20–29, Jan. 1953.

Discussion

Albert D. Emurian (Philco Corp.): In reference to the Anscochrome motion picture which was just shown, what was the last shot you showed us?

Mr. Forrest: That was a picture of a missile photographed against a referenced background with a high-speed camera.

Mr. Emurian: How is this film available? That is, in what sizes or lengths.

Mr. Forrest: Anscochrome 16mm is available in 100 and 200-ft daylight-loading rolls, and in 400-ft rolls on special order. It can also be supplied with single perforation.

In 35mm width, it is available in cartridges for miniature cameras and 100-ft rolls. 400 and 1000-ft rolls are available on special order for special applications.

Richard O. Painter (General Motors Proving Ground): What was the exposure index used in making the shots with the high speed camera?

Mr. Forrest: Those scenes were made at an exposure index of 125. The camera was operating at 3000 frams/sec.

Mr. Painter: I understood that the tungsten balanced film was not recommended for use at an exposure index of 125, only the daylight.

Mr. Forrest: Both Daylight and Tungsten Type Anscochrome film can be exposed at E.I. 125 and the process modified as I have just described in this paper to yield that high speed.

Mr. Painter: Have you any information of reciprocity-law failure of this material at much shorter exposure?

Mr. Forrest: The 3 emulsions used in Anscochrome respond similarly to exposures of various times over a wider range than color films which we have supplied in the past. This is the reason that the very short exposures of the high-speed camera yield acceptable color values.

Mr. Painter: I am thinking of exposures down in the range of 10^{-6} seconds. Would there be any trouble there?

Mr. Forrest: I could not say. That would have to be tried.

Henry Rogers (Rolab Laboratories): What kind of a camera was used for the first three shots?

Mr. Forrest: The first scenes on the demonstration reel were made with a Cine Kodak Special and the last high-speed scenes were made with an Eastman Type-III high-speed camera.

35mm Intermittent Motion-Picture Projector for Color Television

By W. F. FISHER
and WARREN R. ISOM

A 35mm motion-picture projector for use with the three-vidicon film camera for color television is described. The projector employs a modified Geneva intermittent that permits long application of light and nonlocked synchronous operation. The light source is an incandescent lamp. Compensation for variation in film density, without affecting color balance, is provided. The unique accommodation of 24-frames/sec film rate to the 30-frame television system makes the projector adaptable for all storage and semi-storage film pickup systems.

A 35MM INTERMITTENT motion-picture projector has been designed primarily for television reproduction of color film with a three-vidicon film camera. The three-vidicon technique uses one vidicon tube for each of the primary colors of the color film being transmitted (Fig. 1). These vidicons "look" at a real image produced by the projector at a field lens. By the use of a separate lens on each camera and appropriate choice of dichroics and color-shaping filters, each camera sees only the red, the green or the blue components of the color picture. It is worth while to review the design requisites for a projector to be used in such a system before proceeding to the discussion of the means used in obtaining the desired end results.

Monochrome Practice

It has been common practice in monochrome film telecasting to operate the projectors and the synchronizing generator, which controls the scanning circuits of the film camera, from the same 60-cycle power line. This, then, permits one unit to be locked with the other so that an established phase relationship may be maintained. With this tight lock, the projector shutter can be so phased that the light-sensitive surface of the television pickup tube is illuminated by the photographic image of the film that is being projected upon it only during the vertical blanking time of the television system or for a total not exceeding 8% of the available light (Fig. 2).

To operate so as to utilize the full optical efficiency of the projector and with the photographic image on the film projected upon the sensitive surface of the pickup tube without regard to its storage characteristics has long been a dream. Until recently, the difference between the output signal level of any type of pickup tube when it is scanned during the periods between the application of light (storage) and when it is scanned simultaneously with the application of light (nonstorage) was so great that it was normally used either as a storage tube or as a nonstorage tube with little or limited use as both in the same piece of equipment. Also, there was no available film equipment to allow the tubes to be used without reliance on their storage ability. Full nonstorage, or simultaneous, operation makes rigid demands upon film handling machinery. Either continuous projection of the photographic image or film advancement during the vertical blanking time of the television system is required. Both are possible but until recently neither was available. Even now, to obtain high optical efficiency, both types of projectors require a degree of mechanical precision not commonly found in production equipment.

It is not surprising, then, that with previous TV projectors, the exposure of the photosensitive surface of the transducer to light from the projector has been restricted to the vertical blanking interval of the scanning cycle. This restriction is necessary to prevent the appearance of a light application bar which results when the pickup tube is illuminated with the image from the film during part of the scan period. This restriction limits the exposure time to something less than 8% of a scanning field. It also limits the useful optical efficiency of the projector to the same figure. Under some conditions, with monochrome reproduction of dense film, the available light from the projector is marginal.

Color Television Considerations

For monochrome use, there is not complete agreement that this method of exposure during vertical blanking is fully satisfactory. But for color television, this method of operation with its inherent limitations and handicaps cannot readily be employed for film reproduction in a system operating under the present standards. The fundamental barrier to such an approach is the inability to use the 60-cycle power line frequency to synchronize the projector drive with the television scanning circuits. The reason is obvious. Both the horizontal and vertical deflection rates in a color system are derived from the crystal-controlled

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(This paper was first received on June 16, 1955.)

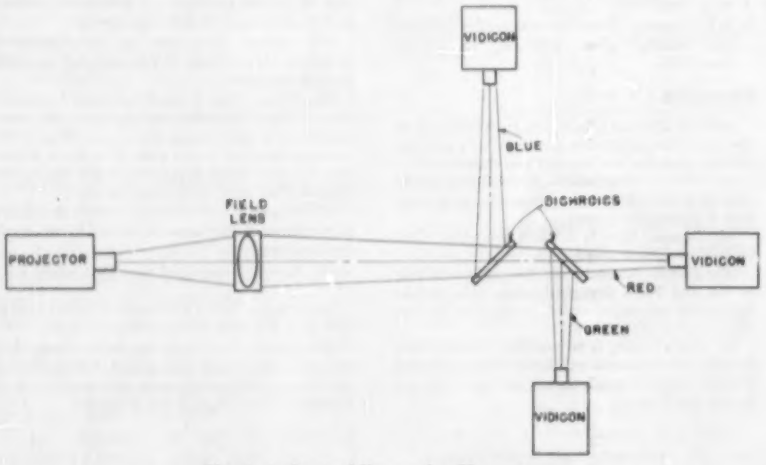


Fig. 1. A three-vidicon color film system.

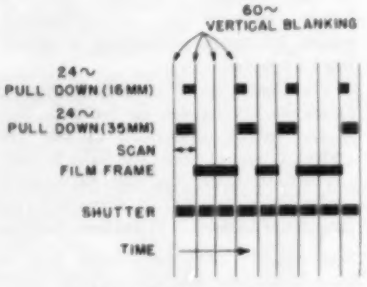


Fig. 2. Prior practice.

subcarrier frequency which is not an integral multiple of the line frequency. In addition, the limiting of exposure time to the vertical blanking period does not provide sufficient light for broadcast quality reproduction of color film. The additional attenuation, due to the color correction filters and color separation dichroics of the system, and the increased average density of color film require a projection system with greater optical efficiency.

Partial Storage and Nonsynchronous Operation

The vidicon pickup tube has been found to have a characteristic such that it can be used as a storage and as a non-storage device in the same application. This characteristic, if certain conditions are met, permits freedom in projector speed. It is no longer necessary to lock the projector to the television system. The requirement is that no part of the signal electrode of the tube is to be scanned more than once per exposure to the photographic image of the film, provided this exposure is in the order of one-third of the field period. It has been determined that if light is applied to the signal electrode of the vidicon for a minimum of 30% of each television field and in the same area, the vidicon scan will convert the image charge to an electrical signal with no practical difference in output level between the periods of storage and non-storage. The application bar is thereby eliminated. With 30% application time, the transition is less than one per cent in amplitude, which is below the threshold of visibility.

Thus, design criteria have been established for projectors which are to be used. The film-advancing cycle, or pull-down time, must be sufficiently short to permit at least the minimum exposure of the signal electrode area of the vidicon required for nonlocked operation. If the pulldown time can allow a longer application of light to the signal electrode, a large light reserve is available for use with films having wide density ranges.

60-Cycle Shutter Required

There is one other condition which must be met in order to operate the camera and projector in a non-locked manner. This is concerned with the way in which the 24-frame motion-picture rate is made commensurate with the 30-frame television system. Unless each scanned field has essentially the same exposure to light, both in timing and quantity, so that the tube acts on storage and nonstorage in the same ratio through each field, an unacceptable flicker will be apparent in the reproduced picture. This is particularly bad if the signal electrode area of the vidicon is in part or in whole scanned twice after exposure to the projection of the photographic

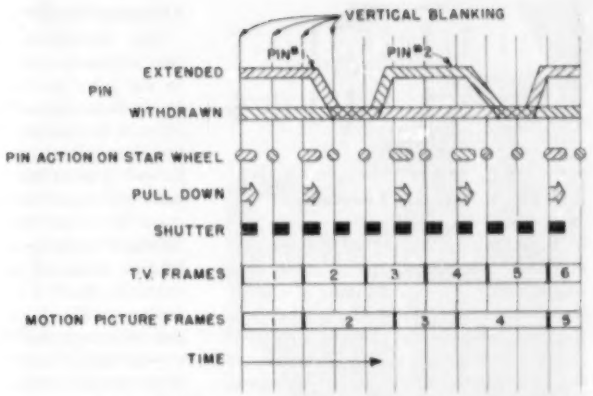


Fig. 3. Relationship between 35mm intermittent, shutter and television scanning in RCA vidicon method.

image. This means that the projector shutter must operate at 60 cycles/sec. The required exposure is met and the undesirable effect is eliminated by holding one frame of film in the gate for two television fields or 1/30 sec and the alternate frame for three television fields or 1/20 sec.

It is shown in Fig. 3 that with this arrangement the time required to show four film frames is identical with that required for five television frames. Figure 3 also shows that the use of a 60-cycle shutter gives equal exposure to the signal electrode area of the vidicon for each scan. The average of 1/20 and 1/30 is 1/24, and 20 frames/sec, alternated with 30- frames/sec, gives a velocity average of 24 frames/sec. A two–three intermittent cycle is required to obtain this relationship.

With all of these requirements and conditions in mind, a design of an intermittent was undertaken. However, certain other considerations were borne in mind.

The Intermittent

The Geneva-movement type of intermittent has rendered such yeoman service to the motion-picture industry that the word Geneva is synonymous with intermittent. Its familiar Maltese Cross could well be a badge of recognition for projectionists. This long record of highly satisfactory operation suggested that this mechanism should be used, if possible, for television service. Even laymen in the field know that one complete rotation of the pinwheel, or cam, produces a quarter turn of the Maltese Cross, or starwheel (Fig. 4). This starwheel and the film-advancing sprocket are on the same shaft. For 35mm film and a four-pointed starwheel, the sprocket must have 16 teeth to advance the film one frame per cycle.

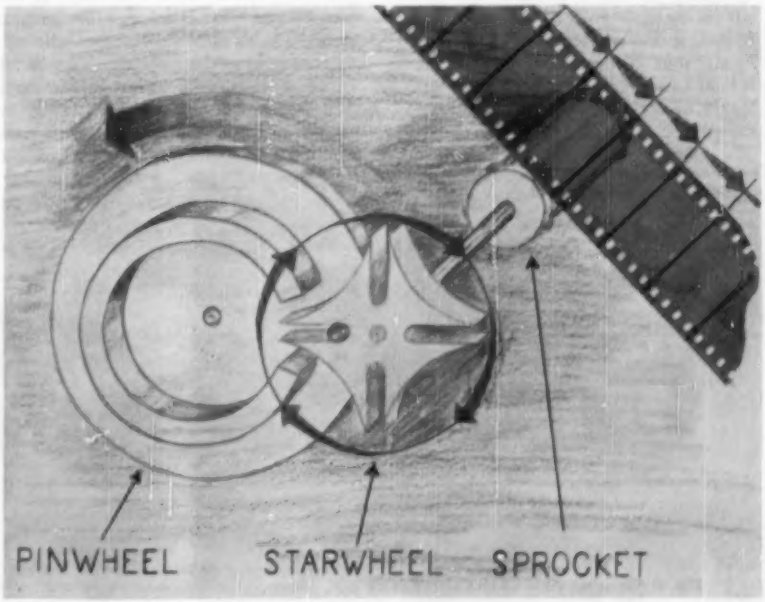


Fig. 4. A Geneva.

Fig. 5. Four skip 1 conversion.

A preliminary survey of the requirements of the three-vidicon color television film camera indicated, of course, that the usual accommodation between the 24 frames/sec rate of the motion-picture system and the 30 frames/sec of the television system was necessary. It is well known that a Geneva can operate at 30 frames. The trick that suggested itself was to operate the Geneva at 30 frames but to modify it to pull film at 24 frames/sec. A quick look at the arithmetic of the relationship between the motion-picture frame rate and the television frame rate revealed that if one film-advancing cycle of every five could be skipped or delayed for the period of one cycle of the 30-cycle rate, the Geneva could be operated at 30-frames/sec speed and the film advanced at a 24-frames/sec rate (Fig. 5). Restating this in terms of the film, this means that every fourth frame of film is held in the gate of the projector twice as long as normally. Tests indicated that this would be satisfactory.

A second look at the arithmetic of the systems was taken to find the lowest usable multiplier. If the television system is considered as a basic 60-cycle system and the film system a 24-cycle system, then $2\frac{1}{2}$ is the multiplier. To make use of this relationship, would require that once every $2\frac{1}{2}$ cycles of the Geneva operating at 30 cycles/sec, the film-advancing cycle must be delayed $\frac{1}{2}$ cycle. Restating this in terms of the film, it means that every second frame of film is held in the gate of the projector 50% longer than the first. This relationship is shown in Fig. 3.

Alternate Pin Technique

The translation of this requirement into mechanism was very apparent, due to the prior decision to use a Maltese Cross Geneva intermittent, if possible. Upon examination of a regular theater projector intermittent, it was seen that if two pins placed 180° apart were used, instead of one, and some provision made by which first one pin and then the other could be selected to actuate the Maltese Cross or starwheel, the Geneva could be used. Figure 3 represents this sequence. Pin 1 engages the starwheel and advances the film one frame. The second time around, it advances the film to the second frame. By the time the pin is ready to advance the film to the third frame, it has already been withdrawn, and the second frame remains in the gate until Pin 2, which has been extended after Pin 1 was withdrawn, engages the starwheel one-half cycle later and advances the film to frame 3. Pin 2 advances the film to frame 4 during the next cycle, but before it can advance the film to frame 5 it is withdrawn. Pin 1, now again extended, advances the film to frame 5. This is the beginning of a new sequence. Four frames of film have served for five frames of television information.

An analysis of the pin action to accomplish this sequence of operation shows it to be very simple and well adapted for cam manipulation. Each pin in succession is extended to actuate the starwheel twice and then withdrawn while the other pin takes over and does the same stint. This action is shown in Fig. 3. The cam required for pin selection is simple with two rises and two dwells. The repetition rate is also low, relatively speaking. This pin selector cam rotates at 360 rpm. However, the pins are in the pinwheel which rotates at 1800. If the pin selector cam is to operate the pins directly so as to avoid linkages, the difference in speed between the pin selector cam and the pinwheel must be 360 rpm. This difference can be either positive or negative. Because of other design considerations, the slower speed, 1440 rpm instead of 2160, was selected.

The total time available for withdrawing and extending the pins is three-fourths of a Geneva cycle. There are two pins 180° apart. The cam design is not complicated if each pin is withdrawn directly after its duty cycle is completed and extended just prior to its actuation of the starwheel. The time available permits a 54° rise of which the design actually uses 50°. This affords an easy tolerance for the phasing of the mechanism. The rise is so gentle that the operation is smooth.

Safety Locks

This completes the modification of a standard Maltese Cross Geneva movement so that it can be operated at 30 cycles/sec but advances film at 24 frames/sec. However, certain safeguards are necessary to insure reliable operation. Particularly, the Geneva lock is involved. The segment of the lock ring beneath the pins must be opened to permit the intermittent to cycle. When the pin is withdrawn, the starwheel is not locked at this point. Especially during threading or starting, there is great likelihood that the starwheel might be rotated and the movement jammed. To prevent this, safety locks were incorporated. These are actuated by a second cam. Even though the pin selector cam could be used for this purpose with linkages to effectively shift its phase 180°, the design was considerably simplified by using a cam for controlling the safety locks.

Over-all views of the completed intermittent are shown in Fig. 6. Notice that the pin selector cam is to the left. The lock-actuating cam is identified by the spring-loaded followers. The pinwheel has one pin extended and the other withdrawn. Figure 7 shows the safety lock beneath the withdrawn pin. It also shows the manner of driving the pin selector cam. It is driven by a shaft within a shaft from the pinwheel driver idler gear. The largest gear is the pinwheel

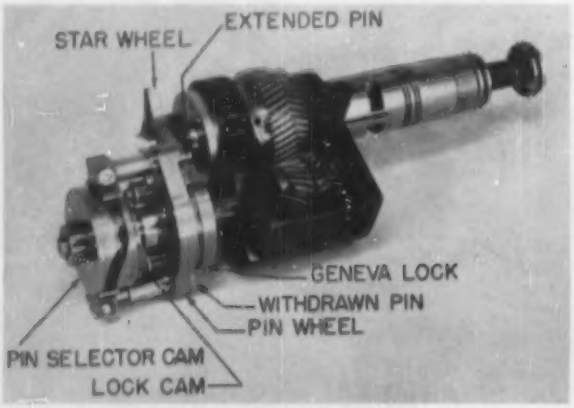


Fig. 6. General view of the alternating pin, 35mm, 60-cycle, 24-frame intermittent.

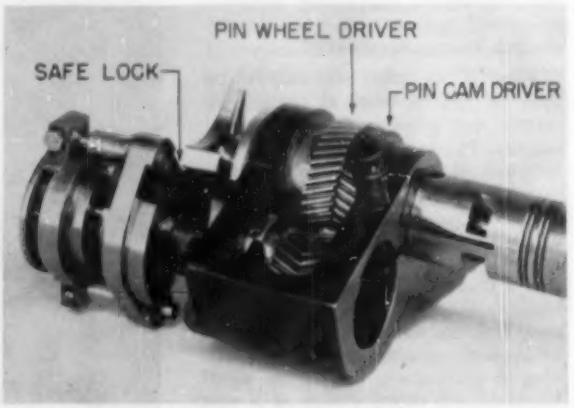


Fig. 7. Detail of the safe-lock.

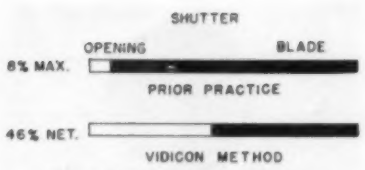


Fig. 8. Transmission efficiency.

driver. The smallest is the driven pinwheel gear. Beside this set is the driver and the driven for the pin selector cam. The two larger driver gears run at the same speed. The driven gear for the selector cam runs 360 rpm slower than the driven pinwheel gear.

The entire unit is lubricated by a continuous drenching of oil. All present indications are that the modification has not affected the operation or the life of the intermittent.

Significance for TV

The modification has made the Geneva intermittent much more flexible and adaptable to many of the new uses that have been introduced as the result of television, the outdoor theater and the wide-screen theater. This particular modification for television use establishes a four-pointed star Geneva as a basically 60-cycle device. It is possible to use it with storage or semi-storage type of film pickup tubes. Its high shutter efficiency — 46% at 60 cycles — permits long exposure of the sensitive surface of vidicons, image orthicons and iconoscopes to the projection of the photographic image on the film during scanning (Fig. 8). Compared to the 8% maximum efficiency of the vertical-blanking-time exposure technique, this gives almost six times as much light. Thus, the peak output signal of the pickup device is available for processing. This increased light output is necessary for the reproduction of film in full color over television using the three-vidicon system. The large light reserve insures a color video signal with a high signal-to-noise ratio. The nonsynchronous operation is a "must" for color television.

While its necessity for color television with the three-vidicon system is admitted, the importance of this projector development for monochrome use with a one-vidicon system must not be overlooked. The high light efficiency of this projection system makes possible superb signal-to-noise ratio. A ratio of 300 to 1 can be obtained. With aperture correction sufficient to obtain essentially 100% response at 350 lines, a ratio of 100 to 1, or 40 db, can be realized. The freedom from noise coupled with the freedom from synchronous operation establishes this projector development as very significant for monochrome use also, particularly in eliminating roll-overs when switching between network and local pickups. Of course, the flashing of the pickup tube during vertical blanking is easily possible if wanted.

Non-TV Uses

For theater use, the intermittent as modified gives a 72° pulldown instead of 90°. This gain can be used directly to eliminate flicker and maintain the same screen brightness. The 60-cycle flicker is not apparent at theater screen brightness, being down some nine to one compared to 48-cycle flicker at the same brightness. To realize more fully the benefits for theater use from this modification principle, the pinwheel is driven 36 rps, and the two pins alternate in actuating the starwheel at a 24-cycles/sec rate. This arrangement increases the optical efficiency to 67%. With a 48-cycle shutter, this 33% increase in efficiency can be converted into increased screen brightness. Probably the practical limit is to operate the pinwheel at 48 rps, use only one pin to actuate the starwheel every other rotation. This modification shortens the pulldown to 45° (Table I). With a 48-cycle shutter, 50% more light can be delivered to the screen, a gain equivalent to about 3½ db. This is significant both in itself and for the possibility that, now that this is done, other things may be possible.

Optical Elements

A 1000-w incandescent lamp of the pre-focus base-up type is used as a source of illumination. The convenience of a tungsten lamp plus the nonblackening characteristic of the base-up construction make a very satisfactory light source for color television film work. The color temperature of this lamp is quite stable over a long time period; its maintenance is very simple and its life very satisfactory. In this application, as in other projectors developed with television use primarily in mind, a quick-change lamp house is used as shown in Fig. 9. This lamp house is so constructed and designed that a new lamp is put in operation within less than one second in case of failure. This is accomplished automatically whenever the filament current of the lamp in use is interrupted. Lamp failure is no longer a source of lost air time. This feature permits a lamp to be used to the full extent of its life. In other words, there is no need to change a lamp in anticipation of its failure.

The second element in the optical system that has received full attention because of the television application for which this project is intended is the condenser optical system (Fig. 10). The condenser optics have been tailored to fit this projector. There are requirements peculiar to this use imposed upon the system. The first concern, of course, was for a flat field and this has been very well achieved. But in addition, the condenser optics are spaced so as to provide for other accommodations. It is realized

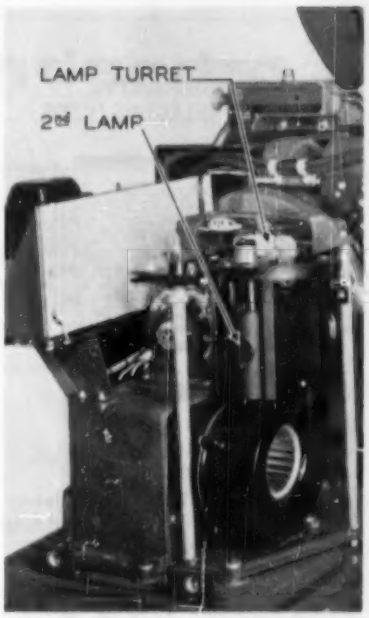


Fig. 9. Automatic lamp replacement turret.

that this machine will be used most frequently with critical color film and almost six times more light available for transmission than is commonly used for monochrome TV. In order to protect this film completely, it was deemed wise to introduce into the condenser a heat filter. A heat filter is obtained by the use of one heat-reflecting and one heat-absorbing element. These two prevent the passage to the film of the heat-transmitting infrared portion of the spectrum of the lamp. In testimony of the effectiveness of this filter is the ability to hold a single frame of color film in the projector gate with the lamp at full brilliance indefinitely. This is more than a testimony; it is positive assurance that the film is not endangered by heat from the light source. It is useful and important to be able to project a single frame in television operation.

Space is provided in the condenser system for the light-interrupting shutter. As has been previously noted, it is important in using a three-vidicon system of color pickup that no portion of the target be scanned twice after exposure to light. It is also well known that projector shutters do not rotate at constant speed. Under the worst conditions of operation this flutter of the shutter has been known

Table I. Theater Use.

Pinwheel, rpm	No. of pins	Shutter frequency	Basic effect
1440	1	48	50%
1800	2	60	50%
2160	2	48	67%
2880	1	48	75%

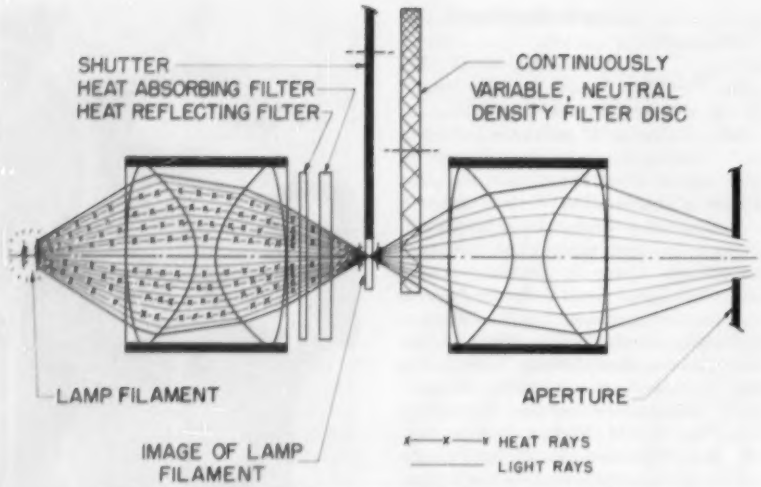


Fig. 10. The relay condenser system providing for heat filtering and brightness control.

to produce a tell-tale bar across the displaying kinescopes. In order to design out of the projector all possibility of this fault, the shutter cuts through the light path in the condenser in the plane of an image of the filament. Since all points of the film aperture are illuminated by each point of the lamp filament, this arrangement insures that the shutter operation is variable density or in the manner of an iris. This elimination of a sharp shutter cutoff permits a wider tolerance on the speed constancy of the shutter than is needed.

The third important special accommodation that the condenser system provides is space for a variable neutral-density filter. The advantage of having a high optical efficiency for the projector is thus realized in the ability to use film of wide density ranges. This system has been already described by Sadashige and Melchionni at this Convention. In effect, a continuously variable neutral-density filter disk is placed into the condenser optical path. The control of the transmission efficiency of the condenser system is located remotely on the video control panel. This permits the maintenance of reference video levels while accommodating wide variations in film density. The objective is a fully corrected $f/1.9$ six-element lens. The speed of the system is fully adequate to insure noise-free operation of the vidicons.

Other Elements

In order to achieve the utmost in reliability, the drive motor is a 3-phase, 220-v, 60-cycle synchronous motor with a d-c field. The separate shutter-drive motor is phase-sensitive and permits rotational phase lock to the drive motor in the most simple and reliable manner without interlocks.

Special attention has also been given to reels and magazines provided for this projector. In many instances, color film has greater thickness than black-and-white film. At times it has been inconvenient if not impossible to load a standard 2700-ft reel with the film required for a 30-min color television show. The reels and magazines supplied with the projector meet this requirement. The same sound-reproducing head that is used with theater-type projectors is a part of this projector. The complete machine is shown in Fig. 11.

The projector has been made strictly compatible with the television system. The projector has an intermittent which permits high optical efficiency so that color film may be used successfully. The projector has a special condenser optical system that makes possible satisfactory operation with films of great density ranges. The drive motors have been selected for their reliability and the other accessories for their special application and high performance. This quick review

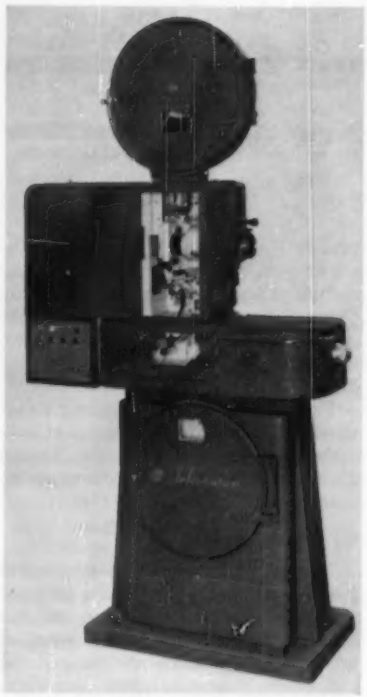


Fig. 11. The RCA Model TP35CC Television Projector.

of the requirements for the reproduction of color film with the three-vidicon film camera reveals how completely they have been met in the projector design described above.

The authors wish to acknowledge the contributions of all of their colleagues in this effort, particularly those of D. J. Parker in designing the optical elements, K. Sadashige and B. F. Melchionni for the variable neutral-density control and H. N. Kozanowski and his associates for the three-vidicon development.

References

H. N. Kozanowski, "3-Vidicon color film camera," *Broadcast News*, No. 79, 8–15, May–June 1954.

R. G. Neuhauser, "Vidicon for film pickup, *Jour. SMPTE, 62:* 142–152, Feb. 1954.

Color Transcription, and other sections, Final Report of Panel 11A, NTSC, November 10, 1953.

J. G. Jackson, "A 60-degree Geneva intermittent movement," *Interna. Project., 30:* 7–26, Feb. 1955.

K. Sadashige and B. F. Melchionni, "Control of light intensity in television projectors," *Jour. SMPTE, 64:* 416–419, Aug. 1955.

motion-picture standards

Three Proposed American Standards

Published here for a three-month period of trial and comment are three proposed American Standards, PH22.103, 35mm CinemaScope Prints with Magnetic Stripes, Usage in Projector; PH22.104, Projector Aperture for 35mm CinemaScope Prints with Magnetic Stripes and PH22.105, Projector Aperture for 35mm Superscope Prints with Optical Sound. All comments should be sent to Henry Kogel, Staff Engineer, prior to March 15, 1956. If no adverse comments are received, the proposals will then be submitted to ASA Sectional Committee PH22 for further processing as American Standards.

These three proposals originated as Motion Picture Research Council Practices and reflect some of the new forms developed recently in the art of motion-picture cinematography and projection. They were submitted for Society consideration sometime around May 1954: PH 22.103 to the Sound Committee and PH22.104 and PH22.105 to the Film Projection Practice Committee, chaired respectively by John Hilliard and Ralph Heacock. Two and three drafts were required before agreement could be reached on these proposals. However, they have now been approved by the above-mentioned committees and the Standards Committee.—H. K.

The 400 American Standards in the Electrical Field is a 60-page booklet which indexes and describes each American Standard in the electrical engineering area. It is designed to help the user and prospective purchaser to find the applicable standard on the product in which he is interested.

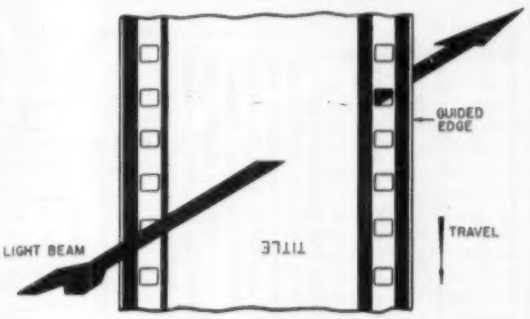
The booklet also gives briefs of each of the current International Electrotechnical Commission recommendations: a listing of all projects under the jurisdiction of the Electrical Standards Board—including officers, sponsors and scopes of these projects. It also contains general information on the work of the American Standards Association, the Electrical Standards Board and the International Electrotechnical Commission. It explains how and why American Standards are developed and describes the benefits to manufacturers, users and the general public. Copies may be obtained free of charge, as long as they last, from the American Standards Association, 70 East 45 St., New York 17.

Proposed American Standard

35mm CinemaScope Prints with Magnetic Stripes

Usage in Projector

PH22.103



Film As Seen From The Light-Source In The Projector

1. Scope

1.1 This standard specifies the location of the photographic emulsion and of the magnetic striping relative to the projector light source and lens, the rate of projection and the relationship between sound and picture of 35mm sound motion-picture film having a 0.073 x 0.078-in. perforation as developed for the CinemaScope process.

2. Position of the Photographic Emulsion and Magnetic Striping

2.1 The photographic emulsion shall be on the side of the film which faces toward the light-source of the projector.

2.2 The magnetic striping shall be on the side of the film which faces toward the lens of the projector.

3. Rate of Projection

3.1 The rate of projection shall be 24 frames/sec.

4. Relationship Between Sound and Picture

4.1 The apparatus and the film shall be so arranged that when the film is threaded normally, the soundtrack is scanned for reproduction at a point 28 frames behind the center line through the picture being projected. Thus, a given point on the film shall pass the picture aperture after it has passed the magnetic soundhead.

NOT APPROVED

Erratum

Proposed American Standard PH22.102 Dimension for 35mm Motion-Picture Film, Alternate Standard for Positive Raw Stock, *Jour. SMPTE, 64:* 634, Nov. 1955.

APPENDIX 2
in the next to the last line
For: 0.950 to 0.935 in.
read: 0.950 to 0.953 in.

Proposed American Standard

Projector Aperture for 35mm CinemaScope Prints With Magnetic Stripes

PH22.104

1. Scope

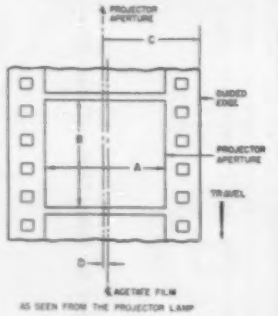
1.1 This standard specifies the dimensions and location of the aperture of projectors used in the projection of 35mm CinemaScope motion pictures employing four magnetic sound records.

2. Dimensions

2.1 The dimensions of the aperture shall be as specified in the diagram and table provided.

2.2 Dimensions A and B are specified for an aspect ratio of 2.55:1 and for a projection angle of zero degrees.

2.3 Undersized apertures are required when the projection angle is greater than zero degrees, so that they may be filed to correct for keystone effect (see Appendix).



Dimensions	Inches	Millimeters
A	0.912 max	23.16 max
B	0.715 max	18.16 max
C	0.708 ± 0.002	17.98 ± 0.05
D	0.019	0.48

APPENDIX

When the projection angle is greater than 0°, an undersized aperture must be used to make allowance for the keystone effect. This aperture would then be filed out to fit the particular projection angle. The bottom of this undersized aperture is filed out to the maximum width, 0.912 in., to obtain the necessary width at the top of the picture. The sides of the aperture are then filed to square off the picture. This results in dimension A being less than the maximum at all points other than at the bottom of the aperture.

When the projection angle is less than 0°, an undersized aperture also must be used to make allowance for the keystone effect. This aperture would then be filed out to fit the particular projection angle. The top of this undersized aperture is filed out to the maximum width, 0.912 in., to obtain the necessary width at the bottom of the picture. The sides of the aperture are then led to square off the picture. This results in dimension A being less than the maximum at all points other than at the top of the aperture.

When a curved screen is used the aperture will also have to be undersized with respect to the B dimension to permit the filing of the top and bottom so that these edges of the picture will appear horizontal on the screen.

NOT APPROVED

Proposed American Standard

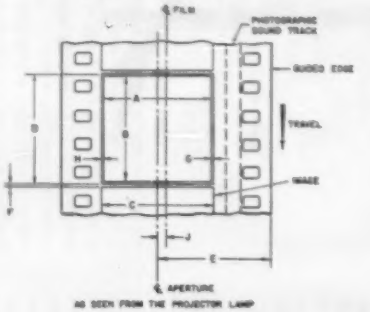
Projector Aperture for 35mm Superscope Prints with Optical Sound

PH22.105

1. Scope

1.1 This standard specifies the dimensions and location of the aperture of projectors used in the projection of 35mm Superscope motion pictures employing one optical sound record.

1.2 It is intended that this aperture will be used in conjunction with 35mm motion-picture film cut and perforated in accordance with American Standard PH22.1-1953, Dimensions for 35mm Motion-Picture Film, Alternate Standards for Either Positive or Negative Raw Stock or PH22.36-1954, Dimensions for 35mm Motion-Picture Positive Raw Stock.



2. Dimensions

2.1 The dimensions of the aperture shall be as specified in the diagram and table provided.

2.2 Dimensions A and B are specified for an aspect ratio of 2:1 and for a projection angle of zero degrees.

2.3 Undersized apertures are required when the projection angle is greater than zero degrees, so that they may be filed to correct for keystone effect (see Appendix).

2.4 It should be noted that the distance of the aperture centerline from the guided edge of the film is the same as for the 0.600 x 0.825-in. aperture specified in PH22.58-1954, Aperture for 35mm Sound Motion-Picture Projectors.

Dimensions	Inches	Millimeters
A	0.715 max	18.16 max
B	0.715 max	18.16 max
C	0.735 min	18.67 min
D	0.735	18.67
E	0.738 ± 0.002	18.75 ± 0.05
F	0.013	0.33
G	0.010	0.25
H	0.010	0.25
J	0.049	1.24

APPENDIX

When the projection angle is greater than 0°, an undersized aperture must be used to make allowance for the keystone effect. This aperture would then be filed out to fit the particular projection angle. The bottom of this undersized aperture is filed out to the maximum width, 0.715 in., to obtain the necessary width at the top of the picture. The sides of the aperture are then filed to square off the picture. This results in dimension A being less than the maximum at all points other than at the bottom of the aperture.

When the projection angle is less than 0°, an undersized aperture also must be used to make allowance for the keystone effect. This aperture would then be filed out to fit the particular projection angle. The top of this undersized aperture is filed out to the maximum width, 0.715 in., to obtain the necessary width at the bottom of the picture. The sides of the aperture are then filed to square off the picture. This results in dimension A being less than the maximum at all points other than at the top of the aperture.

When a curved screen is used the aperture will also have to be undersized with respect to the B dimension to permit the filing of the top and bottom so that these edges of the picture will appear horizontal on the screen.

NOT APPROVED

news and reports

79th Convention

Trends in the way of developing the papers program and in the nature of sessions for Society conventions continue in at least two ways.

More Program Vice-Chairmen

For each of the last few conventions, the Program Chairman has increasingly allocated areas to vice-chairmen for that convention—these in addition to high-speed photography, television and screen brightness topics which have often been handled by vice-chairmen. These program or topics vice-chairmen serve for a specific convention. They are not to be confused with Papers Committee Vice-Chairmen who usually are appointed for two-year terms and who help gather papers for all conventions.

Any member of the Papers Committee (see the April 1955 *Journal*, p. 197) will give advice and gladly facilitate the submission of possible papers for the 79th Convention. The Chairman, and the Vice-Chairmen, by topic, for the forthcoming convention are:

Program Chairman
Bernard D. Plakun
General Precision Laboratory
Pleasantville, N.Y.

Laboratory Practice
W. H. Rivers
Eastman Kodak Co., Room 626
342 Madison Avenue,
New York 17

Motion-Picture Projection Production and Viewing
W. Borberg
General Precision Laboratory
47 Ossining Rd.
Pleasantville, N.Y.

TV Studio Lighting
H. Gurin
National Broadcasting Company
RCA Bldg , Rm. 586, Radio City
New York 20, N.Y.

Popular Papers
H. Barnett
General Precision Equipment Corp.
92 Gold St.
New York 38, N.Y.

High-Speed Photography
J. Waddell
Fairchild Camera & Instrument Corp.
88-06 Van Wyck Expressway
Jamaica 1, N.Y.

Sound Recording
G. Lewin
1573 East 35th St.
Brooklyn 34, N.Y.

TV General and Educational
S. W. Athey
General Precision Laboratory
47 Ossining Rd.
Pleasantville, N.Y.

Screen Brightness
C. E. Heppberger
231 North Miss Street
Naperville, Ill.

The Week's Program

The week's sessions are *tentatively* laid out to follow the order in which we have listed the topics chairmen — laboratory practice on Monday morning and afternoon; a tour of the Du Mont studios on Monday evening; motion-picture projection and viewing on Tuesday, especially Todd-AO papers at the Rivoli Theatre in the morning and also a concurrent session of TV studio lighting; Tuesday evening, an open evening or more motion-picture papers; Wednesday morning and afternoon, concurrent sessions of high-speed photography (at the Statler Hotel) and television studio lighting at NBC's Colonial Theatre; Wednesday evening, popular TV and high-speed photography papers; Thursday morning and afternoon, sound topics; Thursday evening, semiannual banquet and dance; Friday morning, TV in general and education; Friday afternoon, screen brightness.

Developmental and Discussion Papers

In keeping with the policy to have papers that may benefit from discussion, Program Chairman Plakun has added this advice to the "Hints for Authors":

Subject Matter: At conventions, papers which deal with the development trends in the industry are particularly desirable, as are timely tutorial papers. Equipment papers containing only detailed descriptive matter are not desired for oral presentation, as such material can be more effectively and impartially presented at the Equipment Exhibit associated with the Technical Program. At any time, regardless of connection with a convention, equipment and other papers may be tendered for publication in the Journal, and will be reviewed on their own merit. Oral presentation is not a condition for publication.

Exhibits for New York Convention

With the 79th Convention still five months away, sale of exhibit space for the motion-picture and television equipment show to be held in conjunction with the meeting is going remarkably well. Everett Miller of RCA, chairman of the Exhibit Committee reports that 26 of the 32 booths currently available have already been sold. Exhibits will be set up in the Penn Top South of the Hotel Statler in New York City, and will be open from Monday afternoon, April 30, through Friday noon, May 4, to all convention registrants and guests of exhibitors. Contract forms and additional information may be obtained from Mr. Miller at RCA, 411 Fifth Ave., New York 16.

Society Awards

The annual presentation of the Society's awards took place on Tuesday, October 4, 1955, during the 78th SMPTE Convention at the Lake Placid Club.

Honorary Members

In the absence of Fred Bowditch, chairman of the Honorary Membership Committee, Dr. E. K. Carver presented the following citation appointing John George Capstaff to Honorary Membership in the Society.

If amateur motion pictures had never come into being, John George Capstaff would long be remembered for his work on film processing, for his work on additive and subtractive color processes, and for many other developments in the motion-picture field. He is a persistent experimenter who has taught many a theoretical scientist that the impossible can sometimes be achieved. He is a leader who imparted enough of his own qualities to many younger men so that they have always been proud to be known as members of the "Cappy Gang." But it is for his work in the field of amateur motion pictures that he is most widely known.

Successful amateur motion pictures required a film that was safe and inexpensive and that could be underexposed or overexposed and still give a good picture. Acetate film was safe but was expensive. The film could be reduced in size, but it was still expensive. The use of a camera negative and a positive print allowed errors of exposure to be corrected in the print, but required two films to make one print. A reversal process might eliminate half the film cost by eliminating the print film, but the reversal processes had no way of correcting for errors in the original exposure.

Capstaff came up with the answer. He measured the errors in the original exposure, scene by scene, and by a controlled second exposure corrected for these errors. He designed a continuous processing machine on which this correction could be made.

John George Capstaff, a creative thinker who entered a field explored unsuccessfully for twenty years, recognized the unsolved problems, invented the answers to them, and founded a new industry, Home Movies. We are proud to number him among the honorary members of our society.

The Honorary Membership citation to André Debrie was presented by Nathan D. Golden. Mr. Golden also introduced Mme. Debrie. Following is the citation to M. Debrie and his acceptance speech in French, followed by the English translation.

André Debrie started his career at a very early age. When scarcely 16 years old, and not yet out of school, he was already working with his father, Joseph Debrie, in the design of photographic equipment of the quality that was to make his name famous the world over.

In 1907 Mr. Joseph Debrie, who had already built in his modest shop one of the first photographic printing machines, turned over to his son the project of developing a motion-picture camera, with the result that the patent of a camera, the first "Parvo," was issued in the name of Joseph Debrie on September 19, 1908.

In 1911 André Debrie undertook the development of a new machine to perforate film. He designed it himself and had parts and models made, and in three months and ten days succeeded in bringing out the first prototype. During the first World War, André Debrie was attached to the Photographic Service of the Fourth Army (Aviation) where, in view of the resources of his inventive spirit, he was selected to perfect an aerial camera and subsequently he was sent on a mission to Paris to perfect a photographic printer which he had designed to print aerial photographs. When the war was over, succeeding his father, he reconverted the factory to peace-time production and started the manufacture of the Parvo camera.

André Debrie next invented — and has manufactured since 1921 — the first entirely automatic photographic printer for 300-meter film strips, with a limitless number of automatic light changes. This machine, to which he gave the name of Matipo, is constantly being improved and is in service in various versions throughout the world. With the advent of sound film, this machine was modified to permit the reproduction of sound and the superimposition on the silent film of titles in whatever language was required. This obviated cutting the negative every time a change in the language of the titles was necessary.

In 1924 André Debrie, at the request of his customers, decided to add to his line a developing machine of which the basic design was developed in collaboration with George Maurice. He invented, manufactured, and brought out in September 1935 the Multiplex machine. This machine, which developed and dried films in broad daylight, proved a great success.

Technicians had often asked how they could eliminate fade from their cameras, retouch pictures already recorded, and especially how they could combine certain effects. To meet these demands, the Debrie Truca has been built since 1929.

With the advent of sound, using the small silent film put out by Kodak and by Pathé under the name of Pathé-Rural, André Debrie designed and built the sound projector Debrie 16.

André Debrie worked, invented and produced in his factories practically all the equipment used up to the present for the diverse processes, from the Keller-Dorian process to those involving multiple images. He has concentrated on this problem since 1912. He had designed in his father's shop a projector for color films and adapted the Parvo camera to take pictures in color on 35mm film with the aid of filters, one red and the other green. This camera was the basis for the development of the English process Kinemacolor which was exploited in France from 1912 to 1914.

For the reduction of 35mm film to 16mm André Debrie brought out a printing machine capable of reducing the images. This machine produces side by side on a film of 32mm, two 16mm copies of a single 35mm negative.

On October 16, 1926, he patented a camera with multiple lenses permitting for the first time large panoramic spreads. This arrangement, used by Abel Gance in making his film *Napoleon* in 1926, made possible the presentation at the Paris Opera of certain sequences of this film on a screen three times the normal size by the simultaneous projection of three films. This grandiose manifestation produced a profound impression and was the basis for the attempt by the Americans to produce over-size films. In 1929, American interests requested André Debrie to study the problem. Accordingly he designed and constructed for Paramount all the equipment necessary to film in Magnafilm.

From 1940 to 1944 André Debrie worked secretly on the development of a complete installation of microfilming equipment and when the war was over he brought out a series of micro-cameras and accessories for which he took out 54 patents.

Equally worthy of note was a rapid developing machine called Aiglonne, a compact and revolutionary design which threads itself automatically and is able to pass film strips of any length, perforated or unperforated.

The latest achievement of André Debrie is the reduction printer Tipro which permits, in a single operation, the reduction on a single 16mm film of the images and the sound from a 35mm film — the anamorphosis of the soundtrack being replaced by a totally new process which consists of placing two reduced soundtracks side by side.

All the work, all the research, all the inventions achieved *personally* by André Debrie in the course of his brilliant career are covered by 355 French patents and 551 foreign patents, making an impressive total of 906 patents.

This result is due, in large measure, to the professional integrity and the spirit of enterprise which, under the dynamic inspiration of André Debrie and his immediate collaborators, have animated the 400 specialists, designers, workers and supervisors working in the Debrie Establishments which, in 1919, consisted of only 30 persons in the small factory founded by Joseph Debrie.

For his numerous inventions in the motion-picture field, both in black-and-white and in color, and especially for his many contributions in the advancement and development of cameras, projectors, printing and development equipment, we are proud to honor this distinguished and creative son of the Republic of France among the honorary members of our Society.

André Debrie's Acceptance

Monsieur le président, mon cher ami. Mon émotion m'empêche de vous répondre en anglais. Il est vrai que je ne l'ai jamais appris. C'est donc en français que je vous dirai combien je suis ému de cette distinction que veut bien m'accorder la SMPTE. C'est pour moi un très grand honneur, moi qui ne suis pas de votre pays, de me considérer maintenant un peu des vôtres — je dirais même beaucoup des vôtres. Je vais essayer de continuer ce que j'ai fait toute la vie. Je croyais maintenant pouvoir me reposer, mais avec ce diplôme ça va m'obliger à reprendre un nouveau bail et à continuer encore de nombreuses années à travailler dans le cinéma. Il y aura en quelques mois cinquante ans; je ne veux pas dire que je travaillerai encore cinquante ans mais je ferai de tout mon possible pour être parmi vous à cette époque. Avec tous mes remerciements.

[Mr. Chairman, my good friend. Emotion prevents me from replying in English. Also, it is a language I never happened to learn. I shall therefore use French to tell you how moved I am by the distinction the SMPTE has conferred upon me. For me, a stranger in your country, it is a great honor indeed to be able to consider myself now in some small part — or I should say in great measure — one of you. I am going to try to go on doing what I have been doing all my life. I had thought that now I could rest a little, but this certificate is going to compel me to take a new lease on life and look forward to many more years of work in the motion picture business. In a few months now it will have been fifty years. I don't say that I shall work for another fifty, but I shall certainly do my best to remain among you. I thank you very much.]

Loren L. Ryder reported that presentation of a certificate of Honorary Membership to Walt Disney had been made by Dr. Frayne the previous week in New York City (a short film of this presentation was shown later in the proceedings), and the following citation read:

The Society of Motion Picture and Television Engineers has elected Walt Disney to honorary membership . . . for his technical and engineering pioneering and advancement of film techniques . . . and for his wholesome influence on the minds and emotions of children and adults the world over, through the art and medium of motion pictures.

During the past quarter century Walt Disney has marked many a milestone in motion-picture history. He has created a new art form for mass entertainment. With a genius for the magical illusionments of animation he has combined inventions and perfections of mechanical apparatus to give lifelike vitality to pictorial fantasy. He has opened children's minds to new delights and has brought more happy diversion and laughter into the family circle than any other human being.

Through the use and potency of the animated cartoon and the quality of his theatrical and television entertainments, he has helped immeasurably to give mass entertainment in America the stature of a vital necessity.

His career is traced through such events and pictures as the creation of Mickey

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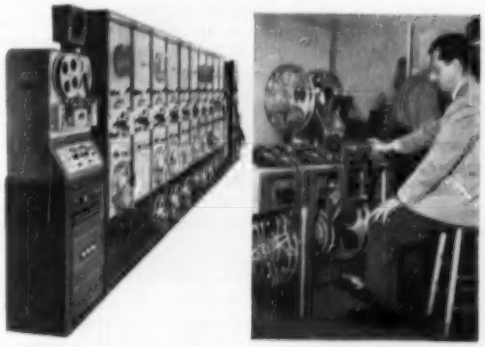

AT LEFT: Lineup of dubbing machines and dubbing recorder. Re-recorded version is 6-track stereophonic sound on 35mm magnetic film. AT RIGHT: Westrex Editer—with 70mm film in the picture gate, and two 35mm sound films, one in the regular gate and one in the special sound head attachment.

Mouse, founder of his fortunes, the production of *Snow White and the Seven Dwarfs*, *Pinocchio* and *Dumbo*, *Cinderella* and *Peter Pan* and other memorable translations of venerable classic fairytales and legends; live-action features like *Treasure Island*, *Robin Hood* and *20,000 Leagues Under the Sea;* wildlife nature epics like *The Living Desert*, *Vanishing Prairie*, *The African Lion*, and the new extension of his creative energies into the television field in the Disneyland and the Mickey Mouse Club programs.

Walt was born in Chicago in 1901, spent a few boyhood years with his family on a Missouri farm, went to grammar school and delivered newspapers in Kansas City. In Chicago he got a bare taste of high school, did odd jobs, briefly attended art school, and at the age of 17, departed for France as a Red Cross ambulance driver. At the close of World War I, back in Kansas City — and too old, he thought, to resume school — he worked in an advertising firm, learned the rudiments of commercial cartoon animation, undertook his first ambitious venture as a business man, went broke, and at the age of 19 scraped together enough money for day coach fare to Hollywood. There he borrowed $500 from an uncle, and with his elder brother, Roy, now president of the company, launched the Walt Disney Productions, presently housed in a 51-acre studio campus in Burbank.

Walt's career came into focus in 1928 with the debut of Mickey Mouse who was to become the most famous and persistent of movie stars. Mickey became the instrument of Walt's imaginative storytelling prowess and the first figure in his fabulous family of cartoon characters. By the time Mickey was well under way, with Walt's own falsetto voice as his breath of life, Disney knew what he himself was, where he was headed, what he wanted to do with his talents and his showmanship. And from then on, through thick and thin, he stuck stubbornly and confidently to his purpose: to bring a special kind of pleasure to the millions who could find enjoyment and enlightenment in visual entertainment in the movie theaters of the nation and the world.

Fellows

Seventeen members of the Society were presented with award certificates elevating them to the grade of Fellow, by Herbert Barnett, Chairman of the Fellow Awards Committee. The new Fellows are:

D. Max Beard
Roger J. Beaudry
Charles C. Davis
Donald G. Fink
Robert M. Fraser
E. Dudley Goodale
George H. Gordon
G. Carleton Hunt
Henry N. Kozanowski
Kenneth M. Mason
J. L. Pettus
Byron Roudabush
Edward Schmidt
Robert E. Shelby
J. Paul Weiss
W. W. Wetzel
William T. Wintringham

From the left: Axel G. Jensen, Elmer W. Engstrom, and John G. Frayne who is presenting the Progress Medal to Dr. Engstrom.

Progress Medal

In the absence of Dr. Otto Sandvik, Chairman of the Progress Medal Award Committee, Dr. Axel G. Jensen introduced Dr. Elmer W. Engstrom, recipient for 1955, and presented him with the following citation:

Dr. Engstrom has long been associated with the sound motion-picture and television fields. After graduation from the university of his native state of Minnesota, he joined the General Electric Co. When sound motion-pictures came into commercial use, he was placed in charge of the company's engineering development and design of sound motion-picture apparatus. Following the transfer of these activities to the Radio Corp. of America in 1930, Dr. Engstrom continued in the development and design of sound motion-picture apparatus as Engineer-in-Charge of the Photophone Division.

Since 1931, Dr. Engstrom has been active in television research. His work on the relationships of scanning rate, brightness and flicker influenced the adoption of interlaced scanning and provided data useful in motion-picture engineering.

The many contributions of the RCA Laboratories to the development of both black-and-white and color television have been the responsibility of Dr. Engstrom. His leadership and guidance have influenced the whole development of television.

Dr. Engstrom's philosophy and insight in the field of industrial research have been well expressed in his many publications and addresses. His fundamental interest in people is evidenced in many of these addresses by the emphasis placed upon the human element in research.

In addition to his duties as Executive Vice-President, Research and Engineering, Radio Corp. of America, Dr. Engstrom is a member of numerous advisory committees in the field of research, embracing industrial, governmental and educational activities. With all his many professional activities, Dr. Engstrom also finds time to take an active and valued part in local community affairs.

For his outstanding leadership and vision in sound motion-picture and television development, Dr. Elmer William Engstrom is awarded the Progress Medal of the Society of Motion Picture and Television Engineers.

Following his acceptance speech Dr. Engstrom gave an address on "New Horizons in Electronics." As an example of the quickening pace in scientific research since the war he cited electronic research, where, he said, a major transformation is in progress as a result of "a revolution in the materials with which electronic science works. This is the field of electronically active solids — materials within which the action of the electron may be controlled with unprecedented precision and efficiency.

"Through continuing research, the family of these new materials is steadily growing. One after another, new substances are being created to perform not only the tasks which were previously performed with conventional materials, but also totally new functions which have never before been possible of attainment. Our electronic science is rapidly overcoming the physical limitations imposed by the materials with which today's electronic systems have been created."

In the fields of mass communications and entertainment, Dr. Engstrom discussed five electronic developments of the future "that now seem possible of achievement on the basis of our present knowledge:

"(1) Mural television, in which the receiver will consist of a thin screen that may be hung upon a wall and controlled remotely from a small box carried around by the viewer.

"(2) Portable television receivers, employing the same type of thin screen and operated by batteries.

"(3) Television tape recorders for use by the broadcasting industry in receiving and storing network and other color television programs for rebroadcast.

"(4) Home television tape recording equipment that may be used for recording scenes to be played back on the television receiver, or for recording and storing favorite television programs for repeated playback.

"(5) Electronic music synthesizers, capable of producing any known tone or any tone which may be imagined, for use as a new source of recorded music.

"Some of these developments will come into use soon, others in the future — within the next decade is probably as certain as we can now be as to timing," continued Dr. Engstrom. "These are but a few of the possible developments in electronics which are resulting from the revolution in materials and our advances in applied research and engineering. In addition, we already are progressing toward an era of pocket-size transistorized radios for personal communication, and toward improved long-distance transmission techniques looking ultimately toward a world-wide television system.

"Perhaps the greatest significance of the materials revolution lies in the fact that such systems and devices as these are not only possible, but that they have been made economically feasible. They are economically feasible because we can now achieve simply, within compact units, a wide range of effects which were previously unattainable, or attainable only through complex, expensive, power-consuming mechanisms."

Concluding, Dr. Engstrom emphasized the general advance in all scientific research, but he pointed also to "a problem which arises because of the very magnitude of all this progress and because of the power inherent in the new instrumentalities. How shall these advances be used — for gain or for loss? Surely you and I immediately answer — for the good of all mankind. But are people over the whole world so disposed and of one mind?

"As we labor to bring these new instrumentalities and services into being, as we labor to put them to use, let us individually and collectively strive so as to be sure that their uses will be constructive — that their uses will advance the purposes of all mankind. Then, and only then, can we say — a job well done!"

Journal Award

Glenn E. Matthews, representing Armin J. Hill, Chairman of the Journal Award Committee, introduced Richard S. O'Brien, winner of the Journal Award for 1954 and presented him with the following citation.

Mr. O'Brien, a graduate of the University of California, is now senior project engineer in the audio-video division of the engineering department of CBS-Television where he has had wide experience in the design and installation of television broadcasting facilities, and in the development of new video systems and devices. At present he is responsible for coordination of the engineering design and installation of all video facilities in the new CBS-TV Chicago studios.

His excellent paper, "CBS Color-Television Staging and Lighting Practices," was an outgrowth of this activity, and was prepared with a view to forestalling some of the problems anticipated as color operations were expanded.

Papers for this award are selected on the basis of technical merit and importance of material, originality and breadth of interest, and excellence of presentation. The committee was unanimous in its selection of Mr. O'Brien's paper because of the high rating he received from each committee member in each of these categories. Furthermore, the committee feels that because of the wealth of pertinent material presented in this paper, and of the concise and usable form in which it is presented, that Mr. O'Brien has made a permanently valuable contribution to the literature of color reproduction and transmission.

Papers selected by the committee and approved by the Board of Governors for honorable mention are:

David L. MacAdam, "Stereoscopic Perception of Size, Shape, Distance and Direction," April 1954;

Ralph M. Evans and W. Lyle Brewer, "Observer Adaptation Requirements in Color Photography and Color Television," July 1954;

Axel G. Jensen, "The Evolution of Modern Television," November 1954.

David Sarnoff Gold Medal

T. Gentry Veal, Chairman of the David Sarnoff Gold Medal Award Committee, introduced Bernard D. Loughlin, winner of the Sarnoff award for 1955, with the following citation:

It is a privilege to be given the opportunity to speak of the accomplishments of Bernard D. Loughlin, who has been chosen by his colleagues in the television industry to receive the David Sarnoff Award of this Society.

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Mr. Loughlin was born in New York City on May 19, 1917. He received a degree of Bachelor of Electrical Engineering from Cooper Union in 1939 and a degree of Master of Science from Stevens Institute of Technology in 1946. He has been employed by the Hazeltine Corporation since June 1939. In his early days there, he made notable advances in the development of frequency modulation and in the design of television receivers. More recently his work has been in the field of color television.

Mr. Loughlin has made many contributions to the science of color television. The most outstanding of these, probably, is the understanding that the optimum method of transmitting a compatible color picture is by the transmission, by normal standards, of a black-and-white picture to which the color information is added. This concept simplified and clarified the process and ultimately resulted in the great advance which the art has made.

Another major contribution of Mr. Loughlin's is the fundamental of "constant luminance." By this principle the monochrome signal carried all of the luminance and the added color signals contribute only to chromaticity. This allows a minimum of color information present in the complete color signal, thereby improving compatibility.

The author of many technical articles and the holder of 36 granted U.S. patents, he had 31 pending applications, many of these pertaining to color television. Mr. Loughlin has also been a major contributor to the formulation of the NTSC Signal Specification through his work on many of the NTSC and RETMA committees.

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Samuel L. Warner Memorial

The winner of the Samuel L. Warner Memorial Award for 1955, Dr. Harry F. Olson, was introduced by William A. Mueller, Chairman of the Warner Award Committee. Mr. Mueller stated:

The Society of Motion Picture and Television Engineers has selected Dr. Harry F. Olson of the Radio Corp. of America as the recipient of its Samuel L. Warner Memorial Award for 1955.

The Warner Award is given to a candidate who has done outstanding work in the field of sound motion-picture engineering and in the development of new and improved methods or apparatus design for sound motion pictures. Dr. Olson was selected for the results of his productive career in audio engineering, including his work on the velocity microphone, the duocone speaker for high-fidelity sound reproduction, and his contributions to the development and improvement of phonograph pickup and recording equipment, underwater sound equipment, and sound motion-picture and public address systems.

Dr. Olson, who is today Director of the RCA Acoustical and Electro-mechanical Research Laboratory, Princeton, N.J., joined that company in 1928. He holds more than 60 patents on devices and systems in the acoustical field and is also the author of more than 70 articles and papers in professional journals, as well as several books including *Applied Acoustics*, *Dynamical Analogies*, *Elements of Acoustical Engineering*, and *Musical Engineering*.

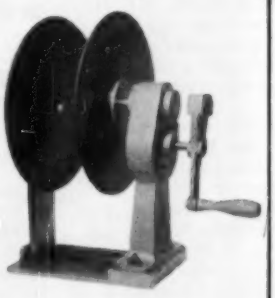
Herbert T. Kalmus Gold Medal

Following presentation of the Fellow award certificates Dr. Frayne announced "the establishment of a new Medal Award. This medal, presented to the Society by the Technicolor Motion Picture Corp., is to be known as the Herbert T. Kalmus Gold Medal Award. It will be available for award annually for outstanding contributions in the development of color films, processes, techniques or equipment useful in making color motion pictures for theater or television use."

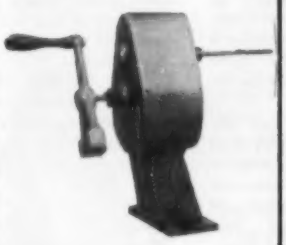
SMPTE Test Films

A new catalog of the test films available from the Society has recently been printed and may be had upon application to the headquarters office. These films, which are planned by the Society's technical committees, now include many that have application in the television field—35mm and 16mm alignment and resolution films, and some very recent 35mm and 16mm color test films and slides. Ten 35mm magnetic four-track CinemaScope films provide a full series of sound and picture tests for wide-screen use, and there are focus-and-alignment, travel ghost and jump-and-weave tests for regular 35mm film. In the 16mm field there are films made to AFA specifications and for testing magnetic azimuth alignment and for multi-frequency tests, as well as a wide range of other films covering all kinds of sound and picture tests. The Society intends these films to be helpful to designers and manufacturers in setting up performance objectives and as standard tools of inspection.

hand rewind



negative rewind set



differential rewind

power rewind

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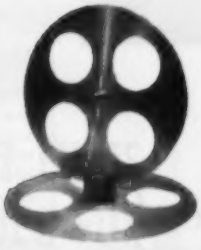
synchronizer

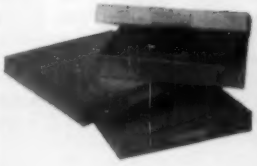
split reels



film racks

editing table

vault cans



swivel base

tightwind

film storage cabinet

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Obituary

Norman F. Oakley, special adviser on motion-picture sales in the Du Pont Company's New York District, died November 4 after an illness of several months. Aged 61, he was in the 40th year of his career with the Du Pont Company.

A veteran in the manufacture and sale of motion-picture films, Mr. Oakley had been associated with the Du Pont Company since its entry into the photo products field. Formerly general supervisor of experimental design, construction, and operation for Monmouth Chemical Company, Keyport, N.J., he joined Du Pont in 1916 as a supervisor of experimental film base production at Parlin, N.J. He was instrumental in the design and operation of Du Pont's first experimental and commercial film manufacturing plants and designed much of the equipment used in the process.

Mr. Oakley entered motion-picture product sales in the late 1920's. He became manager of motion-picture sales in the New York District in 1946, a post which he held until the middle of this year. He was a member of this Society, and of the American Society of Cinematographers, Lambs Club of New York, the Motion Picture Pioneers, and an honorary member of Cameramen's Local 644, IATSE.

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section reports

In the memory of even the oldest **Central Section** member, the Fall Regional Meeting at Minneapolis–St. Paul, October 28–29, 1955, was one of the most outstanding in its history. No little credit for this is due to the fine arrangements made by Bill Wetzel of Minnesota Mining and Reid Ray of Reid H. Ray Film Industries who were co-hosts.

Members arriving from Chicago were met at the station with a truck for their baggage and provided with transportation directly to the new auditorium in the Magnetic Products Research Building where the first sessions were held. A tour of the facilities at Research Products preceded the formal sessions. All methods of magnetic tape testing were demonstrated to the group.

When the first session opened at 4:15 P.M. on Friday, some 85 people were in attendance. Jim Wassell, Central Section Chairman, after his opening remarks, introduced the first speaker, R. A. Von Behren of Minnesota Mining, whose paper was entitled "Some Design Criteria for Magnetic Tape." Don Cain, Production Manager of the Audio-Visual Department at the University of Minnesota, then presented a very interesting paper entitled "Photographic Research at the University of Minnesota." Mr. Cain illustrated the many different ways in which motion-picture photography is used for scientific, industrial and medical research.

On adjournment of the afternoon session, the group was treated to a cocktail party by 3M's Magnetic Products at Conroy's. An excellent dinner followed.

The feature paper of the meeting was given on Friday evening by R. C. McClelland, Manager of Training Services, Eastman Kodak Co., Rochester. His paper, co-authored with Tom Miller, was entitled "Effective Use of Visual Aids in Presentation of Technical Lectures." This presentation was enhanced by several very excellent color slides. Following Mr. McClelland's paper, there was a vigorous discussion which lasted until late in the evening. All hands were ready for the very fine accommodations at the Calhoun Beach Hotel when the session was adjourned.

On Saturday morning at 9 A.M. the session opened on the Reid Ray Film Industries sound stage in St. Paul. A very excellent program was scheduled, including the following papers: "The New Trade in the Fifth Estate," by Bob Shafer, Associate News Director, WCCO-TV; "A Realistic View of Color Photography," by Gordon Ray, Reid H. Ray Film Industries.

After Gordon Ray's paper, the various types of 35mm and 16mm color production techniques were illustrated by projection. This again provoked a very interesting discussion period shared in by everyone.

The group was then conducted on a complete tour of the facilities at Reid Ray, including stage, art and animation, editing, processing, etc.

Caught in deep concentration during one of the 3M meetings are left to right, Jim Wassell, and co-hosts Bill Wetzel, 3M, and Reid Ray, Reid H. Ray Film Industries.

One of the highlights of the entire meeting was the luncheon on the sound stage prepared and served under the direction of Mrs. Reid Ray. The ninety-odd people in attendance for the morning session thoroughly enjoyed the splendid menu.

Immediately after lunch the group was transported to the University of Minnesota stadium where they witnessed the Intersectional football game between Southern California and Minnesota. Despite the freezing snow which fell during most of the afternoon, no one left early. Minnesota won a very exciting game 26–19.

The success of this meeting, evidenced by the many favorable remarks from those in attendance, has indicated to Central Section management that it would be desirable to have more one-day meetings throughout the year with papers on many different subjects to interest a wider audience. Plans in this regard are already being discussed.—*Kenneth M. Mason*, Secretary-Treasurer, c/o Eastman Kodak Co., 137 N. Wabash Ave., Chicago 2.

The Atlantic Coast Section's most recent program meeting was held on Tuesday, November 1st, at the Adelphi Theater studios of the Allen B. Du Mont Laboratories, Inc. The meeting was originally scheduled to begin with the actual production photography of Jackie Gleason's show "The Honeymooners" as well as a presentation of the paper which T. T. Goldsmith and J. L. Caddigan of Allen B. Du Mont Laboratories gave at the recent Lake Placid convention titled "The Electronicam TV-Film System."

The day before the meeting it was discovered that the live production had been cancelled and it was necessary to substitute a 35mm film print of a previous program which had not yet appeared on the air. In addition to the formal paper, Mr. Caddigan gave a demonstration of the Electronicam production techniques using "The Honeymooners" set with members of the SMPTE audience as impromptu actors. In addition, members of our audience were given an opportunity to try their hand at directing a television production via the

SMPTE now has available 35mm and 16mm color television test films and slides designed for TV station use under specifications set up by the SMPTE Television Committee—representing the quality of color material obtainable from Ansco, Technicolor and Eastman prints.

☐ The picture-only films have three sections of five scenes each.

☐ Gray scale at start of first scene can be used in set-up or for adjusting signal generating equipment so that the chrominance subcarrier vanishes with given set-up.

☐ Same high quality picture material in both films and slides.

☐ Slides include one black-and-white chart of the alignment and resolution target used in standard television test films.

☐ All scenes illuminated for shooting with a lighting ratio of approximately 2:1; i.e. key light was twice fill light, measured in foot candles.

35mm Color TV Test Film—approx. 700 ft.

16mm Color TV Test Film—approx. 280 ft.

Set of 10 2 × 2 in. Slides

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- Measures uniformity of illumination and discoloration of projection screens for any distance or angle
- Maintains standard brightness and COLOR TEMPERATURE of printer lights

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Electronicam system. Following these demonstrations, a question and answer discussion period was conducted with Dr. Goldsmith, Messrs. Caddigan, Tingley, Pounds and Haines of the Du Mont Laboratories providing answers for the various aspects of the system.

The attendance was between 350 and 400.—*George H. Gordon*, Secretary-Treasurer, c/o Eastman Kodak Co., 342 Madison Ave., New York 17.

The regular monthly meeting of the **Pacific Coast Section** was held on the evening of Tuesday, November 15, at CBS-Television City, Hollywood, with 205 members and guests attending.

Raymond Thursby of United Productions of America presented a 16mm cartoon *When Magoo Flew*. The speaker then discussed the problems involved and the technique used in producing the 16mm and 35mm CinemaScope versions of this production, including the adaptation of the fixed-field CinemaScope lens to the animation stand.

"The Use of a GPL Closed-Circuit TV System for the Music Recording of *The King and I* at Twentieth Century-Fox" was discussed by Warren Delaplain and Douglas Williams of Twentieth Century-Fox, Robert Hunsicker of General Precision Laboratory and William Born of Kittleson Co. In this musical production it was required that simultaneous with the photography of a ballet scene on one stage, recordings be made of the orchestra on a second stage and of vocalists and narrators on a third stage. The entire number was under the direction of music director Alfred Newman, conducting on one of the stages. A three-way closed-circuit industrial TV unit was used as a visual monitoring tool to permit all necessary parties in each of the locations to monitor the actions at each location. Many other possible applications of the closed-loop television system as a motion-picture studio production tool were visualized.

The Pacific Coast Section is greatly indebted to the Columbia Broadcasting System for their cooperation and hospitality in providing Studio 33, one of their largest audience participation stages for this technical meeting. Lester Bowman, Director of Technical Operations, CBS Hollywood, was responsible for making the arrangements to use the studio.—*E. W. Templin*, Secretary-Treasurer, c/o Westrex Corp., 6601 Romaine St., Hollywood 38.

Education, Industry News

CHCT-TV, a year-old station in Calgary, Alberta, has just started telecasting live shows. Herb Stewart, formerly of Columbus Ohio, is running the 100,000-w station, which now broadcasts over a 100- to 400-mile radius to about 33,000 TV sets in Southern Alberta.

The first Canadian outlet for TV was the Montreal station built in 1952. CBC announced the same year that private TV would be allowed in Canadian cities where there was no CBC outlet. The new station is the result of negotiations among the directors of Calgary's three radio stations. The directors of CHCT-TV are H. G. Love of CFCN, President; A. M. Cairns of CFAC, secretary-treasurer; F. R. Shaw and A. R. Mackenzie of CKXL; H. R. Carson of CFAC; and James Love of CFCN.

Axel G. Jensen, Engineering Vice-President of the Society and Director of Research for Bell Telephone Laboratories, has been nominated by President Frayne as a director of the American Standards Association. This nomination is for a three-year term, commencing January 1, 1955.

Dr. Jensen has been active in the standards work of both the SMPTE and the ASA, and served last June as International Chairman of the meetings of the Technical Committee on Cinematography of the International Organization for Standardization in Stockholm.

Among the associations and technical societies currently represented by members on the ASA Board are: Radio-Electronics-Television Manufacturers Association, American Society of Civil Engineers, Society of Automotive Engineers, American Society of Mechanical Engineers, National Fire Protection Association and the American Gas Association.

New York University is now transmitting two English courses over closed-circuit television to several classrooms on the Washington Square campus. The first university to experiment with closed-circuit television for classroom teaching was Pennsylvania State University, which has recently published a detailed study of its experience. At NYU Thomas C. Pollock, Dean of Washington Square College, and Oscar Cargill, Chairman of the English Department, are in charge of the experiment, which is financed by a grant from the Fund for the Advancement of Education.

The National Association of Educational Broadcasters has published the results of a survey on radio and television broadcasts for college, high school or other credit, made by Robert Underwood. Throughout the country educational institutions of grade school, high school and college level are offering courses over both commercial and educational radio and TV stations to be viewed in the home and then accepted as accredited within the school curriculum.

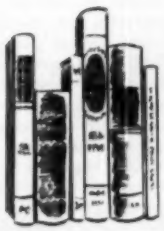
The college courses offered cover art, English, history, the humanities, foreign languages, mathematics, music and psychology. The requirements for receiving credit at the college level vary slightly at different institutions but for the most part these are:

(1) Registration under the same conditions as a resident student.

(2) Payment of a fee, usually varying with the amount of credit given.

(3) The purchase of a text or kit for home study.

(4) Satisfactory completion of a written examination which is given on the campus.



books reviewed

Filmadresboek Voor Nederland

(Film Directory for the Netherlands) Published (1954) by Institut Voor Filmdocumentatie, Postbus 5102, Amsterdam. 227 pp. 5½ × 8½, paper bound. Price f 3.75 (approx. $1.00).

This book is more than a simple directory. It lists and indexes Dutch importers, producers, laboratories, distributors, theaters, circuits, advertising firms, associations, periodicals and books. Although presented in the Dutch language, information can be readily extracted from the tabular listings by those whose only reading language is either English or French. A word list and a table of abbreviations provide essential vocabulary information in these languages.—*Willy Borberg*, General Precision Laboratory Inc., Pleasantville, N.Y.

The National Association of Educational Broadcasters, 14 Gregory Hall, Urbana, Ill., is offering many technical publications and recordings upon request by membership as well as the general public. These include:

X-5: *Technical Directory*. May 1955. 19 pp. Paper. 50¢

X-7: *NAEB Engineering Newsletter*. Quarterly. 20 pp. Paper. $2.00 per year.

W-8: *NAEB First TV Engineering Workshop — 1954*. April 1955. 133 pp. Paper. $2.00. Report of the production workshop for persons engaged in educational television, held at Michigan State University, Aug. 23–Sept. 10, 1954.

Seven Engineering Committee Reports include:

E-1: *Television Equipment* by Carl Menzer. May 1953. 25 pp. Paper. 50¢

E-2: *Motion Pictures and Kinescope Recording for Educational Television* by Vernon Putnam. May 1953. 11 pp. Paper. 50¢

E-3: *Operating Techniques for Video Recorders* by Keith K. Ketcham and Herbert T. Krajewski. July 1953. 11 pp. Paper. 50

E-4: *Engineering Operations Problems Based on Three Years of Operation (WOI-TV)*. Nov. 1953. 4 pp. Paper. 50¢

E-5: *The Theory of Video Recording* by Joseph W. Belcher. Mar. 1954. 19 pp. Paper. 50¢

E-6: *NAEB Tape Recording* by Carl Menzer. Apr. 1954. 6 pp. Paper. 50¢

E-7: *AM-FM-TV Equipment* by Carl Menzer. May 1955. 7 pp. 50¢

Criteria for Business-Sponsored Educational Films, a 16-page booklet issued by the Association of National Advertisers, 285 Madison Ave., New York 17, considers how business can aid education through the production of films that meet curriculum needs of the nation's schools. The criteria are outlined in 22 basic points grouped under 4 main categories — basic educational approach, subject matter, production and distribution. John Flory of Eastman Kodak, chairman of the A.N.A. Films Steering Committee, points out that nearly all advertising and public relations films are available for classroom use. "However, some pictures are unacceptable or ineffective because the sponsor did not take into account the requirements of school people. We are trying to correct this situation."

Picture Proof Technical Section is an 8-page photo-offset publication issued monthly and available from Box 4561, Washington 17, D.C. Picture Proof attempts to extract news of research, research administration, and education for research, and it emphasizes particularly reports of transactions abroad which might not otherwise come to the attention of American scientists. For instance, the September and October issues of Picture Proof carried a first-hand report of an international symposium on applied research held in Nancy, France. Picture Proof's policy is to emphasize material translated into English and to supply translations of

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complete articles at standard rates. Abstracts of international research reports are published in Picture Proof. A book review section covers a wide variety of subject matter.

Film Users' Guide is a new 16mm film information service announced by Film Council of America, through which 16mm film sponsors, producers and distributors may get publicity about their films into 1000 key film information centers. Data submitted to FCA is edited, published and mailed biweekly in packets of twenty titles each to all public libraries with film-lending services, all public libraries serving populations of 20,000 or more, and all FCA Preview Centers. At four-month intervals FCA will publish subject-title indexes; a cumulative index will be published annually. The entire service will be free to the 1000 centers. To have a title publicized in the Film Users' Guide costs $30. Further information, and Work Forms on which to enter information about titles, may be obtained from Film Council of America, 600 Davis St., Evanston, Ill.

The *Radio-Electronic Master*, which is the new title of *Radio's Master*, is now available in the 1956 (20th) edition through electronic parts distributors. The publishers consider the new title more appropriate to the wider scope of the volume's coverage which now has been broadened to include electronic parts for television as well as radio.

The *Master* is designed for those who buy, specify and manufacture electronic parts and equipment. The 1456-page volume, the largest to date, includes the products of practically all manufacturers of standard components and equipment in the industry. Complete descriptions and specifications are included with prices, as well as more than 11,000 illustrations.

A few of the products cataloged in the 1956 edition which are of particular interest to motion-picture and television engineers are: receiving and transmitting tubes, special purpose tubes, sound and public address equipment, recording equipment, TV and radio chassis, speakers, horns, projectors, wire, cable, testing and measuring equipment, metal cabinets and racks, transformers, controls, power conversion equipment, TV antennas and systems, TV parts and accessories, hardware, etc. Detailed indexes help pinpoint the product information of 350 manufacturers.

The *Radio-Electronic Master* may be obtained from electronic parts distributors whose names will be furnished on request by United Catalog Publishers, Inc., 108 Lafayette St., New York 13.

Wild, baby, flutter, tail and some 400 other terms, ranging from aberration to zoom lens, are defined in a glossary for 16mm nontheatrical motion picture personnel, published in the Summer 1955 issue of the University Film Producers Association's Journal. The growing number of people involved in 16mm production and exhibition makes a uniform vocabulary imperative. One source for entries is the SMPTE-sponsored *ASA222.56–1947 American Standard Nomenclature for Motion Picture Film Used in Studies and Processing Laboratories*. Other sources are a *Glossary* prepared by the Theatre Arts Dept. of the University of California at Los Angeles and *A Selected Glossary for Motion Picture Technicians*, Reprint No. 23 of the Academy of Motion Picture Arts and Sciences. The source of all entries is indicated by a key. Many entries were prepared by UFPA members.

The UFPA Journal issue containing the glossary is available at 50 cents a copy, or 40 cents a copy in lots of 50, from the University Film Producers Association, Television Center, University of Iowa, Iowa City, Iowa.

Papers Presented at Lake Placid Oct. 3-7, 1955

The listing below includes two high-speed photography papers which were not shown in the printed program received by those who attended the Convention. There are also corrections in authorship in two instances, two papers withdrawn from the program at a very late date are omitted, and one paper has been moved from Friday afternoon to Tuesday morning which was when it was read.

Two of the papers on this program appear in this issue of the *Journal;* five or more others will appear in December; and most of the remainder which have already been, or are now being, put into final shape for publication will appear during the first quarter of next year.

Monday Morning — Materials and Standards

Polyester Photographic Film Base, D. R. White, C. J. Gass, E. Meschter and Wilton R. Holm, *E. I. du Pont de Nemours & Co., Inc., Parlin, N. J.*

Science and Technology in Color Motion-Picture Photography, C. J. Staud, *Eastman Kodak Co., Rochester, N.Y.*

A Chairman Looks at Stockholm, Axel G. Jensen, *Bell Telephone Laboratories, Inc., Murray Hill, N.J.*

Progress Toward International Motion-Picture Standards, D. R. White, *E. I. du Pont de Nemours & Co., Inc., Parlin, N.J.*

Monday Afternoon — Studio Practice

An Evaluation of Certain Methods of Using Exposure Meters, A. L. Sorem, *Eastman Kodak Co., Rochester, N.Y.*

A 225-Amp Motion-Picture Studio Carbon for Use With 3200–3400 K Color Film, F. P. Holloway, C. A. Plaskett and R. B. Dull, *National Carbon Co., Fostoria, Ohio;* and C. W. Handley, *National Carbon Co., Los Angeles*

Production Evaluation of the 225-Amp Low Color Temperature Carbon, W. F.

"...miraculously...blown up to wide screen size"(from 16mm)

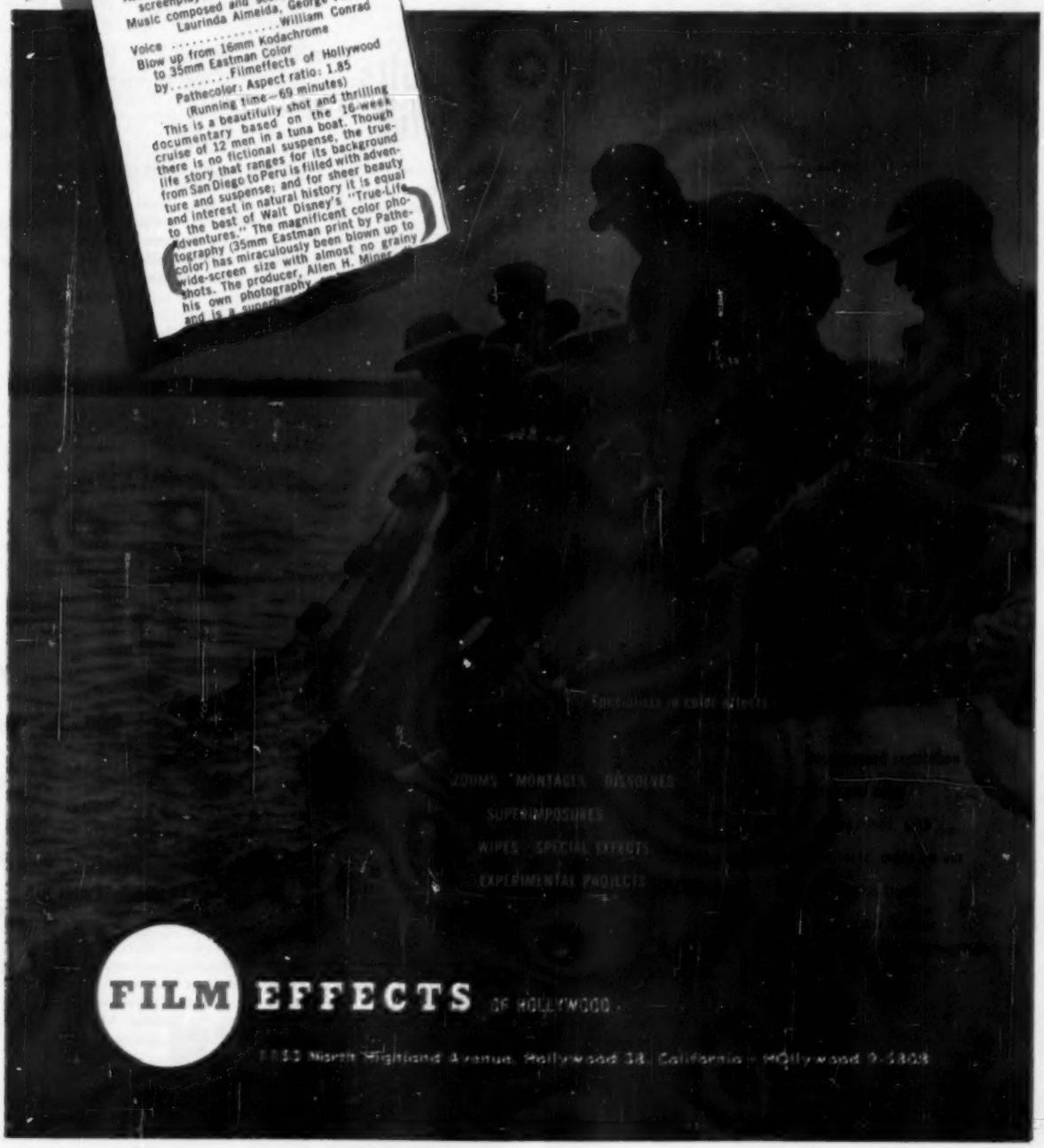
Hollywood Reporter
Wed., Oct. 26, 1955

'Naked Sea' Fine Documentary Pic

"NAKED SEA"
(Theatre Productions-RKO Radio)
Produced, directed, photographed by.....Allen H. Miner
Associate producer, screenplay.....Gerald Schnitzer
Music composed and scored by.....Laurinda Almeida, George Fields
Voice.....William Conrad
Blow up from 16mm Kodachrome to 35mm Eastman Color by.....Filmeffects of Hollywood
Pathecolor: Aspect ratio: 1.85
(Running time—69 minutes)

This is a beautifully shot and thrilling documentary based on the 16-week cruise of 12 men in a tuna boat. Though there is no fictional suspense, the true-life story that ranges for its background from San Diego to Peru is filled with adventure and suspense; and for sheer beauty and interest in natural history it is equal to the best of Walt Disney's "True-Life Adventures." The magnificent color photography (35mm Eastman print by Pathecolor) has miraculously been blown up to wide-screen size with almost no grainy shots. The producer, Allen H. Miner, his own photography

We appreciate such comments on our work, however, blow-ups from 16mm that render superb results in 35mm is the rule and not the exception at Filmeffects of Hollywood.



KELLEY, *Motion Picture Research Council, Inc., Hollywood*

Color in Television Studio Lighting, R. G. WILLIAMS, *Century Lighting, Inc., New York*

A New Hand-Held Lightweight Double-Frame VistaVision Camera, TECHNICAL STAFF, *Paramount Pictures Corp., Hollywood, Calif.*

Motion-Picture Studio Production Problems — Round Table Discussion, W. A. MUELLER, *Warner Bros. Pictures, Burbank, Calif.*; L. L. RYDER, *Paramount Pictures Corp., Hollywood*; E. I. SPONABLE, *20th Century-Fox Film Corp., New York*; PETER MOLE, *Mole-Richardson Co., Hollywood*

Tuesday Morning — Projection and Viewing

New Concepts of Perspecta Sound and Projection Control Practice, R. A. HAINES, *Far East Army and Air Force Motion Picture Service, APO 500 (Tokyo, Japan) San Francisco*

New Field Developments for Military Theater Circuit Modernization, R. A. HAINES, *Far East Army and Air Force Motion Picture Service, APO 500 (Tokyo, Japan) San Francisco*

A Noncommercial Participation-Type Theater, ARTHUR L. SMITH, *Colonial Williamsburg, Williamsburg, Va.*

A New 8mm Copper-Coated Carbon for Motion-Picture Projection, F. P. HOLLOWAY and R. B. DULL, *The National Carbon Co., Fostoria, Ohio*

This Is Cinerama, W. ROBERT DRESSER, *Cinerama Inc., New York*

Report of the Committee on 16mm and 8mm Motion Pictures, M. G. TOWNSLEY, *Committee Chairman*

Reduction of Temperatures on Motion-Picture and Television Sets Using Heat Control Coatings, F. E. CARLSON and G. T. HOWARD, *General Electric Co., Cleveland*; A. F. TURNER and H. H. SCHROEDER, *Bausch & Lomb Optical Co., Rochester, N.Y.*

Tuesday Afternoon — Projection and Viewing

Todd-AO Motion-Picture System, BRIAN O'BRIEN, *American Optical Co., Southbridge, Mass.*

Perception of Color in Projected and Televised Pictures, D. L. MACADAM, *Eastman Kodak Co., Rochester, N.Y.*

Effects of Visual Angle on Visual Perception, S. M. NEWHALL, *Eastman Kodak Co., Rochester, N.Y.*

Projecting for the Wide Screen — Round Table Discussion, G. C. HIGGINS, *Eastman Kodak Co., Rochester, N.Y.*; A. E. NEUMER, *Wollensak Optical Co., Rochester, N.Y.*; WILLY BORBERG, *General Precision Laboratory, Pleasantville, N.Y.*; G. GAGLIARDI, *Stanley Warner Theatres, Englewood, N.J.*

Wednesday Morning — Laboratory Practice

The Testing of Plastics for Use in Contact With Photographic Processing Solutions, B. A. HUTCHINS, *Eastman Kodak Co., Rochester, N.Y.*

The Role of the Chemist in the Processing Laboratory, L. E. WEST, *Eastman Kodak Co., Rochester, N.Y.*

A Quality Control Program for Motion-Picture Laboratories, C. L. GRAHAM and R. T. RYAN, *Eastman Kodak Co., Rochester, N.Y.*

Some Principles of Spray Processing, J. R. TURNER and E. W. JENSEN, *Eastman Kodak Co., Rochester, N.Y.*

Electronic Printing — The Answer to Many 16mm Sound Problems, ROGER J. BEAUDRY, *Shelly Films, Ltd., Toronto, Ontario*

Wednesday Afternoon — Laboratory Practice

Cleaning Motion-Picture Film, D. W. FASSETT, F. J. KOLB, JR., and E. M. WEIGEL, *Eastman Kodak Co., Rochester, N.Y.*

A Uniform Blackbody Light Source Excited by Radio Frequency, S. C. PEEK, *Sylvania Electric Products Inc., Salem, Mass.*

The Design of Color Motion-Picture Printers, J. G. STREIFFERT, *Eastman Kodak Co., Rochester, N.Y.*

Report of the Color Committee, J. P. WEISS, *Committee Chairman*

Professional Printing Techniques for Ansco Color Negative-Positive Motion-Picture Film, KARL SCHADLICH, *Ansco, Binghamton, N.Y.*

Processing Anscochrome Motion-Picture Films for Industrial and Scientific Applications, JOHN FORREST, *Ansco, Binghamton, N.Y.*

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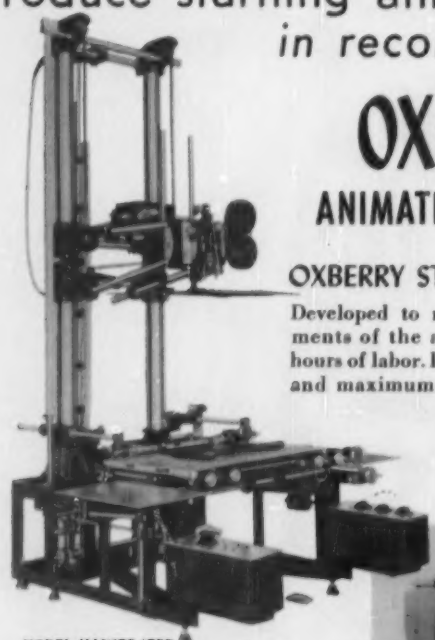

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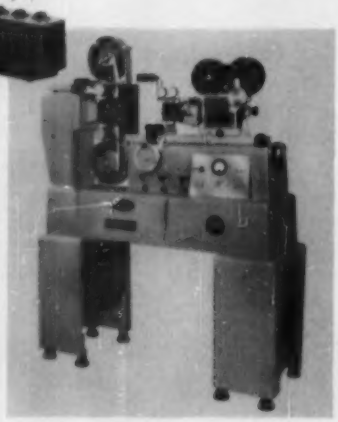

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Thursday Morning — Television

Problems of Network Broadcasting in Monochrome and Color — Round Table Discussion, R. E. SHELBY, *National Broadcasting Co., New York;* W. L. LODGE, *CBS Television, New York;* FRANK MARX, *American Broadcasting Co., New York;* F. A. COWAN, *American Telephone and Telegraph Co., New York;* P. B. LAESER, *WTMJ-TV, The Journal Co., Milwaukee, Wis.*

Thursday Morning — High-Speed Photography

The Iconolog — A Semi-Automatic XY Coordinate Film-Reading Device for Recording and Tabulation of Data in Decimal-Digital Form, RALPH E. BROWN *Genisco, Inc., Los Angeles*

A New Film Reading Machine of Great Versatility, BERNARD S. BENSON, *Benson-Lehner Corp., Los Angeles*

Some New Aspects of Photogrammetric Equipment, JOHN A. EIKELMAN, *Coleman Engineering Co., Los Angeles*

Data Reduction Techniques and Equipment for High-Speed Film, ERNEST KHOUGAZ, *Telecomputing Corp., Washington, D.C.*

Thursday Afternoon — High-Speed Photography

A Single-Sweep High-Speed Strip Camera for Rocket Research, KURT STEHLING, J. F. FREELAND and R. SCHMIDT, *Bell Aircraft Corp., Niagara Falls, N.Y.*

Improvements in Rotating Prism Camera Design, JOHN H. WADDELL, *Fairchild Camera and Instrument Corp., Jamaica, N.Y.*

Proposed Terminology for High Speed Photography and Photographic Instrumentation, KENNETH MORGAN, *Fairchild Camera and Instrument Corp., Jamaica, N.Y.*

Principles of Microsecond Photography, MORTON SULTANOFF, *Aberdeen Proving Ground, Md.*

Thursday Afternoon — Television Practice

A New Look at Colorimetry, D. L. MACADAM, *Eastman Kodak Co., Rochester, N.Y.*

Colorimetric Problems in the Use of Film for Color Television, H. N. KOZANOWSKI and S. L. BENDELL, *Radio Corp. of America, Camden, N.J.*

Grainless Phosphor Screens for Television Tubes and the Light Amplifier, F. J. STUDER, *General Electric Research Laboratory, Schenectady, N.Y.*

Television Vertical Aperture Compensation, A. C. SCHROEDER and W. G. GIBSON, *RCA Laboratories Div., Princeton, N.J.*

The Electronicam TV-Film System, T. T. GOLDSMITH and J. CADDIGAN, *Allen B. Du Mont Laboratories, Inc., Clifton, N.J.*

Friday Morning — Educational Television

Are We Educating by Television? MRS. G. G. BRODERICK, *U.S. Office of Education, Dept. of Health, Education and Welfare, Washington, D.C.*

Activities of the Joint Committee on Educational Television, E. A. HUNGERFORD, JR., *Metropolitan Educational Television Assn., New York*

A National Educational Television Program Service, A. M. DELAND and L. M. NELSON, *Educational Television and Radio Center, Ann Arbor, Mich.*

Friday Morning — Television Equipment

Optical Multiplexing in Television Film Equipment, A. H. LIND and B. F. MELCHIONNI, *Radio Corp. of America, Camden, N.J.*

Inquiry Into Density Standards for Television Slides, R. H. HILL, *Williams and Hill Ltd., Toronto, Ontario*

A Remote Control Multi-Scene Switching Preset System, E. F. KOOK and F. M. WOLFF, *Century Lighting, Inc., New York*

Friday Afternoon — Television and Sound

Television Studio Practices Relative to Kinescope Recording, HAROLD WRIGHT, *Canadian Broadcasting Corp., Toronto, Ontario*

The Conversion from Optical to Magnetic Sound in Television Systems, H. C. WOHLRAB, *Siemens & Halske, A. G., Karlsruhe, Germany*

The Process of Magnetization in Magnetic Tapes, WALTER GUCKENBURG, *Institute of Technical Acoustics, Technical University, Berlin-Charlottenburg, Germany*

"Sprocketape" Recording System, C. E. BEACHELL, *National Film Board of Canada, Ottawa*

Peterson

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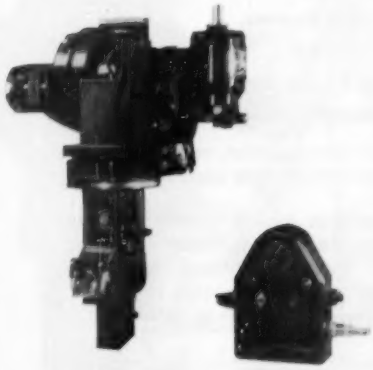
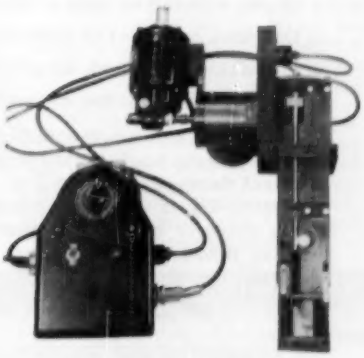
- MODEL "J" & "D" PRINTERS with standard 300 watt lamphouse.



Fade Unit shown inserted in lamphouse.

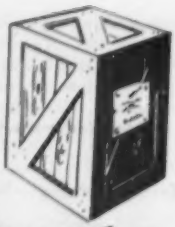


Fade Unit complete with control panel.

Send for catalog of Motion Picture Printing Equipment and Accessories.

MOTION PICTURE PRINTING EQUIPMENT CO.
Mfrs. of Optical and Continuous Printers and Accessories
8136 NORTH LAWNDALE AVENUE • SKOKIE ILLINOIS

Write today for prices and complete literature.



new products

(and developments)

Further information about these items can be obtained direct from the addresses given. As in the case of technical papers, the Society is not responsible for manufacturers' statements, and publication of these items does not constitute endorsement of the products or services.

Kodachrome and Kodacolor processing chemicals and color print materials have been announced by Eastman Kodak Co. as available for commercial distribution. Included are the following products:

Chemicals for processing 35mm and 828 Kodachrome Roll Film; Kodachrome Film Splicing Tape — a thermoplastic splicing tape for use in splicing together individual rolls of Kodachrome Film prior to processing; Kodak Gel-Coated Film Leader, 35mm; Kodak Color Print Material, Type K—the material now used by Kodak in the production of Kodachrome prints; Chemicals for processing Kodak Color Print Material, Type K; Kodak Internegative Color Film — the film used by Kodak in the production of color negatives from Kodachrome transparencies from which the company produces Kodacolor prints; Chemicals for processing Kodacolor Film; chemicals for processing Kodak Internegative Color Film; Kodak Color Print Material, Type III — the print material on which Kodacolor prints are now made; and chemicals for processing Kodak Color Print Material, Type III.

Kodak Papers, a new and completely revised edition of Kodak's Data Book, has just been issued. In this edition the section dealing with the physical and photographic characteristics of Kodak papers has been brought up to date and the balance of the 64 pages has been largely re-written. One-third of the book is entirely new.

Containing the latest information on all the important factors which affect paper characteristics and paper quality, including new methods of speed evaluation and changes in manufacturing techniques, this Data Book is designed to be of maximum helpfulness to the professional user of photographic papers as well as the advanced amateur.

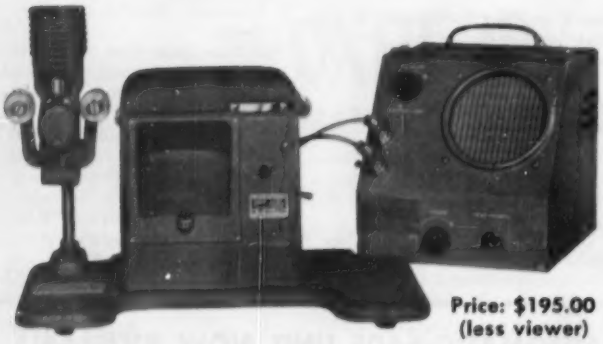
New among the subjects covered are discussions on: contrast variations within a given paper through developer-exposure manipulation; photometric methods of printer control; the use of the densitometer in determining negative quality, paper grade and printing exposure; choosing a paper surface for particular scenes; dimensional stability of papers; and testing procedures to determine print permanence.

Kodak Papers is punched to fit the Kodak Reference Handbook. It is priced at 55 cents and is available through Kodak dealers.

The Synctron Model 250 Cine-Light is a new portable light designed for motion-picture taking and available from Dormitzer Electric & Mfg Co., 5 Hadley St., Cambridge 40, Mass. With an output of 250 w of light for a minimum of 20 min, it is powered by a hermetically sealed nickel cadmium battery having an operating temperature range of −25 F to +145 F. The battery can be charged over 1000 times with a retention of approximately 90% of its original capacity. The light has a power of 800 lm-sec and 3400 K. The entire unit, including built-in automatic 4-hr charger and trickle charger, voltmeter and power source, weighs 18 lb enclosed in the carrying case. Price: $325.00.

YOU'VE ALWAYS WANTED IT . . .

AND HERE IT IS!



Price: $195.00
(less viewer)

THE

DUAL READER

- Play SOUND with ANY 16mm motion picture viewer.
- Edit SOUND and PICTURE in perfect synchronization.
- For SINGLE and DOUBLE system editing.
- Works with left to right or right to left viewers.
- Operates on 110–120 volts 60 cycles AC.
- Includes sound head, amplifier, and base for viewer.
- Smart modern design, attractive brown wrinkle finish.

SOUND HEAD, pre-focused exciter lamp socket, reads variable area or density track, highly polished and chrome plated film track will not damage your film.

AMPLIFIER, 5 watt output with built-in Alnico speaker, exciter lamp rheostat control, speaker can be moved away from the editing table, headphone jack for listening without disturbing others.

SEND FOR DESCRIPTIVE LITERATURE!

THE CAMERA • MART INC.

MOTION PICTURE AND TV EQUIPMENT

1845 BROADWAY at 60th St.
NEW YORK 23, NEW YORK

PHONE: Circle 6-0930
CABLE: CAMERAMART

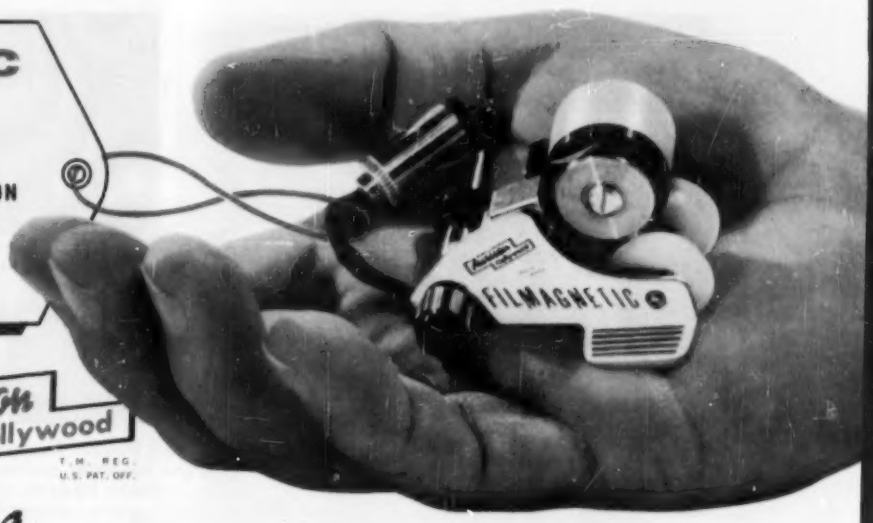
FILMAGNETIC
TRADE MARK

AN *Optional* FEATURE

AVAILABLE FOR FACTORY INSTALLATION

ON ALL NEW OR EXISTING AURICON

OPTICAL SOUND-ON-FILM CAMERAS



Auricon Hollywood

T. M. REG. U.S. PAT. OFF.

Presenting AURICON FILMAGNETIC

TRADE MARK

Auricon proudly presents "Filmagnetic" High-Fidelity sound-on-film Recording, for lip-synchronized Talking Pictures and Music of Quality, on 16 mm black and white or color film pre-striped for magnetic sound before it is exposed to light. "Filmagnetic" sound and optical picture are recorded Single-System on the same film at the same time! The "Filmagnetic" Unit, installed at the Factory in any Auricon Camera, can be temporarily removed without the use of tools, thus providing a choice of High-Fidelity Optical or Magnetic sound-tracks. Your pre-striped film with magnetic sound lip-synchronized to your picture, passes through the normal picture-development and is played back on any 16 mm Magnetic Sound Projector, including the Ampro, B&H, RCA, and others.

"Filmagnetic" Outfit complete . . . $870.00

PLEASE MAIL COUPON BELOW FOR FREE INFORMATION . . .

"FILMAGNETIC" SOUND FOR COLOR OR BLACK & WHITE

(FILMAGNETIC PATENTS PENDING)

"Filmagnetic" Twin-Head Camera Recording Unit, with Record and Instant-Monitor Magnetic Heads, which automatically open for easy threading . . . complete with Model MA-10 Amplifier, $870.00 installed on any new Auricon Camera at the Factory. Small extra installation charge on existing Auricon Cameras.

"Filmagnetic" 3 Input Amplifier, Model MA-10, with High-Fidelity Microphone, complete Cables and Batteries, in a Cowhide-Leather Carrying Case. Super-portable, weighs only 7 pounds, carries easily with shoulder-strap during operation!

Auricon Hollywood

GUARANTEE

All Auricon Equipment is sold with a 30 day money-back guarantee. You must be satisfied!

Auricon Hollywood — 16 MM SOUND-ON-FILM SINCE 1931

AURICON Division
BERNDT-BACH, INC.
6946 Romaine Street
Hollywood 38, California

☐ Please send me free information on "Filmagnetic" equipment for Auricon Cameras.

☐ Without obligation, please send me cost of installing "Filmagnetic" on my Auricon Model.....Camera.

NAME.....TITLE.....

FIRM.....

STREET.....

CITY.....ZONE.....STATE.....

Distributed by Graybar
OFFICES IN PRINCIPAL CITIES

THE Auricon Hollywood LINE

CINE-VOICE $695.00

AURICON PRO-600 $1497.00

SUPER 1200 $4652.15

Closed-circuit theater television was not only again in operation this Fall by Theatre Network Television, Inc., for the Marciano-Moore fight but also for telesessions such as that at the opening of a new building of the Hospital for Special Surgery in New York. In directing and operating these closed-circuit presentations, Theater Network Television is using General Precision Laboratory television projection systems, the latest of which is Model PB-611B designed as a mobile unit which can be rented by theaters for special TV events or telesessions. The projector, the control rack and the power supply are all on wheels for rolling into a theater or hall. For small theaters there is a completely self-contained projection system in one mobile unit. In the hospital session shown above, less than half the experts attending could be accommodated in the auditorium; the remainder followed the session on GPL receivers in hospital classrooms.

Animation Techniques: A new 30-min, 16mm sound film with one sequence in color, showing animated motion-picture techniques and how they are accomplished with motorized camera and artwork mechanisms, is available from John Oxberry, Animation Equipment Corp., 38 Hudson St., New Rochelle, N.Y.

The script starts with motorized zoom motion, executed with automatic camera focusing from a 30 field to a 3 field, at both slow and high speeds. North-south motion is dealt with in connection with scroll titles and the action of bar tracks is explained.

Two forms of bi-motion are shown: (1) a camera zoom combined with a pan in one direction, (2) an east-west pan combined with a north-south pan. Tri-motion involving motorized zoom, east-west and north-south movements taking place simultaneously is covered in detail. The importance of the pantograph is shown in motorized pans and free-wheeling work where art and table movements depend on operator dexterity.

One sequence deals with slide motion and the problem of handling artwork of varied dimensions. Another part of the film deals with underlighting, overlighting, bipack printing and double exposure. Silhouette, traveling matte and eraser techniques are explained.

The last section of the film is devoted to multiple-plane or 3-D effects wherein the multispeed stop-motion motor plays a key role in frame-by-frame shooting. The finale demonstrates 3-D animation in color and with music.

The **Gruen Watch Company** announced the formation of a new company, a subsidiary to be located in Cincinnati, called Gruen Precision Laboratories that will develop precision products for industry, defense and the consumer markets.

Establishment of the laboratories is the beginning of a long-range program of expansion and diversification, under the direction of the President, Edward H. Weitzen. The early work of the laboratories will be as a prime and subcontractor on defense projects doing research and development. Products developed by the laboratories will be manufactured by the Gruen Precision Products Division.

In addition to industrial and defense products, the watch company is concentrating on developing consumer items.

Membership Certificates (Active and Associate members only). Attractive hand-engrossed certificates, suitable for framing for display in offices or homes, may be obtained by writing to Society headquarters, at 55 West 42d St., New York 36, Price: $2.50.

Professional Junior Tripod

—used by more professional cameramen than any other tripod in the world.

Shown with friction type head which handles all 16mm cameras, with or without motor. Also 35mm B & H Eyemo, DeVry. Interchangeable with gear drive head. "Baby" tripod base and "Hi-Hat" also available.

If you're a professional—you need "Professional Junior" Tripod. See it today.

SALES • SERVICE • RENTALS

*9.5mm Lenses in 16mm C mount. 18.5mm (extreme wide angle-flat field) Lenses available in mounts for all 35 mm Motion Picture Cameras.
*PHOTO RESEARCH Color Temperature Meters. *Electric Footage Timers
*Neumade and Hollywood Film Company cutting room equipment.
*Griswold & B.&H. Hot Splicers. *DOLLIES—Bardwell-McAlister, Mole Richardson, Century and Colortran Lighting Equipment.

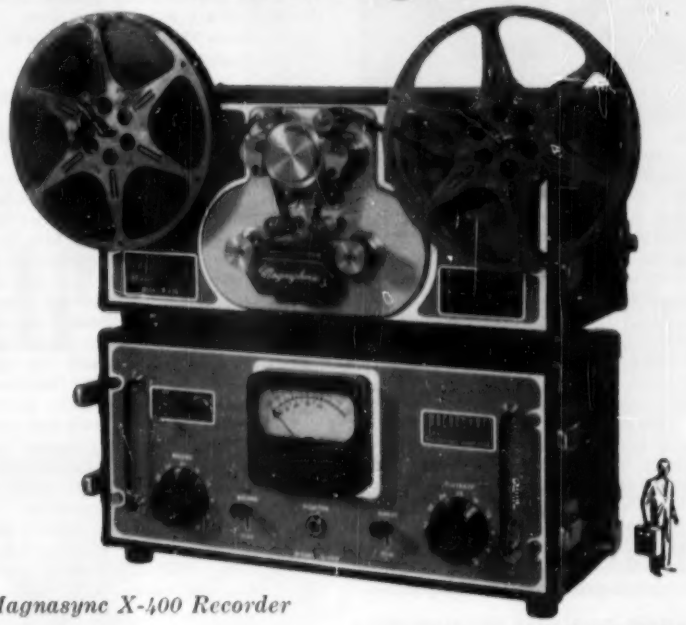
Complete line of 16mm and 35mm Cameras

SPLICES NOT HOLDING? Try Jefrona all-purpose cement. Send for FREE sample.

FRANK C. ZUCKER
CAMERA EQUIPMENT CO.
1600 BROADWAY NEW YORK CITY

a complete

27-lb. sound system!



Magnasync X-400 Recorder

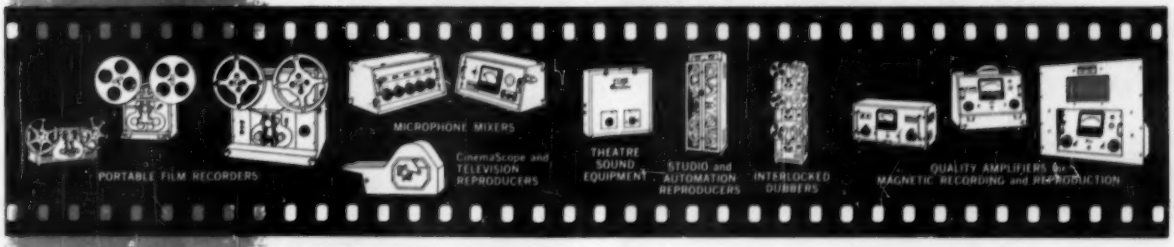
Producer Net Price **$895.00**
F.O.B. North Hollywood, Calif.

FEATURING...

- High gain "long-shot" microphone channel.
- Dialog equalization for "speech-music" selection.
- Self-contained playback system for "film-direct" monitor.
- Famous Magnasync "Synkinetic" precision film transport.
- High speed rewind, sync speed reverse and fast forward.
- Convenient arrangement for "sync marking."
- Footage counter, extended capacity arms, "quick-detach" mount for special motors, projector cable interlocks and many other compatible accessories to help increase production efficiency.
- Unconditionally guaranteed specifications.

send for complete specifications and delivery schedule.

INTERNATIONAL LEADERS IN THE DESIGN AND MANUFACTURE OF QUALITY MAGNETIC FILM RECORDING DEVICES



MAGNASYNC MANUFACTURING CO., Ltd., 5546 Satsuma Ave., North Hollywood 2, California

MAGNASYNC
Magnaphonic SOUND SYSTEM

DEALERS

NEW YORK—Camera Equipment Co., 1600 Broadway, New York 19. JUdson 6-1420. Cable Address CINEQUIP.

CHICAGO—Zenith Cinema Service, Inc., 3252 Foster Ave., Chicago 25, Ill. IRving 8-2104.

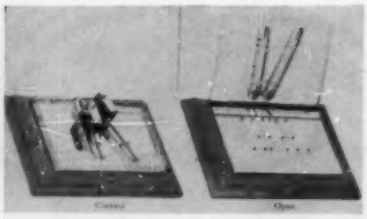
SAN FRANCISCO—Brooks Camera Co., 45 Kearney St., San Francisco, Calif. EXbrook 2-7348.

CANADA—Alex L. Clark, Ltd., 3745 Bloor St., Toronto 18, Ontario. BElmont 1-3303.

The **Auricon Filmagnetic** is an optional feature, available for factory installation on all new or existing Auricon sound-on-film cameras, consisting of a magnetic recording unit weighing 4 oz and a 7-lb amplifier fitted in a leather carrying case. Once installed at the factory, the unit can be temporarily removed from the camera without the use of tools, thus providing a choice of optical or magnetic soundtracks. The unit records while the picture is being shot, with earphone monitoring of the recorded soundtrack. A selector switch on the Filmagnetic Amplifier Model MA-10 permits monitoring directly from the microphone during rehearsals when the camera is not running.

Either "camera-original" film with lip-synchronized Filmagnetic sound, or a Filmagnetic print, can be shown on any 16mm magnetic sound projector. Prints with optical soundtracks re-recorded from the Filmagnetic "camera-original" soundtrack can also be re-recorded onto 35mm optical or magnetic sound-on-film, together with 35mm picture enlarged on an optical printer from 16mm. According to the manufacturer, this is the first of a series of magnetic recording products which will be made available to producers of 16mm sound-on-film motion pictures. Further details may be had from A. N. Brown, Sales Manager, Berndt-Bach, Inc., 6900 Romaine St., Hollywood 38.

A magnetic model of their **Dual Reader** is announced by Camera Mart, Inc., 1845 Broadway, New York 23. The optical version of this equipment was described in the New Products section of the September *Journal*. The magnetic playback head is adjustable to track position for 16mm, 17.5mm and 35mm magnetic film, as well as to 16mm and 35mm Magnastripe film. As with the optical model the new magnetic unit may be used with any 16mm or 35mm silent motion-picture viewer to match picture with single or double system sound. In combination with the optical sound reproduction head, the Dual Reader offers film editors the possibility of checking a 35mm composite picture with optical sound against a second magnetic track. When the film has both Magnastripe and optical track together on the same film, the combination Dual Reader will check one against the other. The magnetic model complete with amplifier and base is priced at $185.00. The combination optical-magnetic model is priced at $295.00.



Ace Clear Vision 35mm and 16mm Splicing Machine is a new splicer designed by Irving I. Merkur of the Ace Electric Mfg. Co. for the splicing of standard acetate film and also of du Pont's new "Cronar" polyester film base. Camera Equipment, Inc., 1600 Broadway, New York, is the sole distributor.

Film from 16mm to 70mm can be handled by the splicer, which is constructed of aluminum, lucite and Tobin bronze and contains no magnetic material. The only ferrous material used is in the nonmagnetic steel cutting blades. Instead of cement, du Pont's Mylar splicing tape is used as the splicing agent, perforated to conform with motion-picture film sprocket holes. Precut portions of this tape are removed from a paper backing by the projectionist and applied to the film when it is registered in the splicer.

Electrothermal heating tape, announced by Arthur S. LaPine Co., 6001 S. Knox Ave., Chicago 29, is offered for many new industrial applications, such as on pipes, valves, gas cylinders, spray guns and injection molding machines. The tapes can be used for heating frozen water lines or cold oil lines. The current-carrying resistance bands are insulated on both sides by layers of knitted glass yarn, permitting its use on metal. The tape comes in ½-, 1-, 2- and 3½-in. widths and in lengths of 2, 4, 6 and 8 ft.

Cinema Engineering Co., Division of Aerovox Corp, Burbank, Calif., issued a 20-page catalog covering its encapsulated resistors. Illustrated are both the CE 100 and the CE 200 series for axial wire terminals, radial wire terminals and radial lug terminals. The PW 100 series and the PW 200 series are for printed circuitry. Dimensional detail, wattage ratings, maximum resistance and military equivalents are stated. The bulletin is No. LC-1030-A. available direct from the factory and sales representatives offices.

Now Finer Lenses for Finer Projection with a True Speed of f/1.7 in all sizes where fast lenses are needed.

From Kollmorgen . . . the newest, fastest projection lenses. Engineered to give you the brightest, clearest, sharpest, most uniform picture you have ever seen.

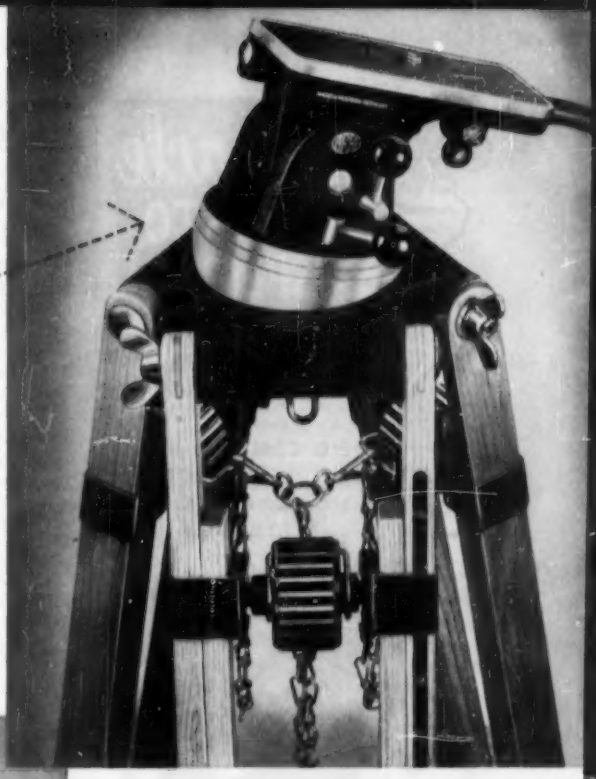
For more information ask for Bulletin 222.

KOLLMORGEN Optical CORPORATION

Plant: 347 King Street, Northampton, Massachusetts

New York Office: 30 Church Street, New York 7, New York

The Hemispherical Ball-Joint Head

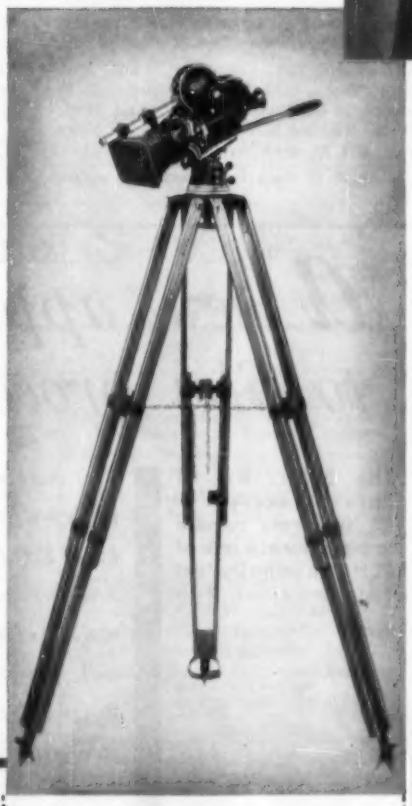


AN EXCLUSIVE FEATURE OF THE NEW

ARRI 16 TRIPOD

Here's the kind of tripod you'd expect from the maker of the famous Arriflex cameras — a tripod with the most advanced features in the field.

One outstanding Arri-exclusive is the Hemispherical Ball-Joint Head. No matter how uneven the ground or how tilted the tripod — this head permits you to level your camera without touching the tripod legs. And a built-in spirit level tells you when you're 'set'.



THE ARRI 16 TRIPOD

Also gives you these important features:

- **HEMISPHERICAL BALL-JOINT HEAD** — precision-machined ball-and-socket (4½" diam.) perfectly mated for easy adjustment and secure locking action.
- **PAN and TILT LOCKS** — each controlled independently.
- **ADJUSTABLE PAN HANDLE** — conveniently located for optimum leverage — can be held under armpit leaving hands free to manipulate lenses and camera.
- **SMOOTH PAN and TILT MOVEMENTS** — achieved through precise machining of all metal parts.
- **SPIRIT LEVEL** — for lining up camera.
- **PATENTED TRIPOD SCREW** — fits both foreign and American tripod sockets. Outside thread section is for foreign cameras. When used with American cameras, it retracts, and inner "American thread" engages camera.
- **SINGLE LOCK COLLAR** — securely locks each leg at desired extension and automatically equalizes locking pressure on both shanks.
- **CALIBRATED LEG SCALES** — permit quick and easy setting of all legs to same extension.
- **ADJUSTABLE ANTI-SLIP CHAINS** — restrict leg spread and prevent tripod from falling.
- **TIE-DOWN EYELETS** — for securing tripod to floor.
- **TIE-DOWN LIPS** — for attaching to dolly or clamps.
- **DUAL SPURS** — double, hardened steel tips assure firm, sure footing.
- **CONSTRUCTION** — legs made of seasoned beech for extra strength and sturdiness. Metal parts are made of brass, steel and aluminum — exposed surfaces finished in black crinkle and chrome. Camera platform is leather-covered.

FOR **LOW ANGLE** SHOOTING . . .

ARRI 16 SHORTY

Supplied less head. Uses Hemispherical Ball-Joint Head interchangeably with Arri 16 Tripod.

SPECIFICATIONS:

	ARRI 16 TRIPOD	ARRI 16 SHORTY
WEIGHT	13½ lbs.	8½ lbs. less head
WORKING HEIGHT		
Maximum	65 inches	21 inches
Minimum	15 inches	9 inches
CLOSED	42 inches	22½ inches
PRICE	$175.00 complete	$90.00 less head

NOTE: Prices, Weights and Measurements include Head, except where otherwise stated, and are subject to change.

KLING PHOTO CORP.

235 Fourth Ave., New York 3, N. Y.
7303 Melrose Ave., Hollywood 46, Cal.

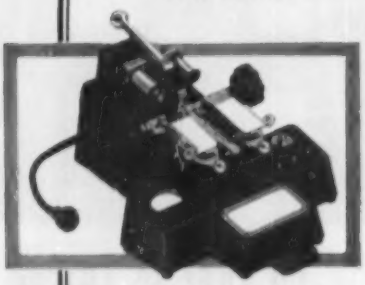
Miracle PRESTO SPLICER

Now available for splicing all kinds of film including

Cronar (Polyester Base), Cinemascope etc., neg or print and Magnetic film or track.

* NO CEMENT
* NO LOST PICTURE
* NO SCRAPING

In 10 Seconds!



Check these advantages:

- A film fusion (butt-weld), end-to-end, No Double Thickness.
- No drying, no overlap
- No lights required

Send for Literature & Sample Splice!

NEW, TOO . . .

MT-1M PRESTO SPLICER

for welding together

¼ MYLAR & ACETATE TAPES

without cement or adhesives

- Diagonal cut capable of withstanding 3 pound pull
- Inaudible with playback amplifier gain at maximum

$67. f.o.b.

Modernize your Picture Technique!

Send for Literature & Sample Splice!

PRESTOSEAL MFG CORP.

37-27 33rd st. Long Island City 1, N.Y.

Journals Available and Wanted

These notices are published as a service to expedite disposal and acquisition of out-of-print Journals. Please write direct to the persons and addresses listed.

Available

Sept., 1937; March, 1939; June, 1939; July–Dec. 1941; 1942 through 1953; 1954 complete, with exception of Dec.; 1955 to date. Available only as entire lot. Write E. J. Mauthner, 310 Riverside Drive, New York 25.

Jan. 1930 through Dec. 1937, Journal SMPE issues; Jan. 1930 through Dec. 1935, bound volumes of SMPE Journal; SMPE Transactions: Apr. 1919:8; May 1920:10; May 1922:13; Oct. 1922:15; May 1925:21; Oct. 1925:24; Apr. 1927:30; Sept. 1927:32; Apr. 1928:33; Sept. 1928:36; SMPE Membership Listings: 1928, 1930, 1938; SMPE Index and Authors: 1930–1935; SMPE Miscellaneous: ASA Z22—1930; Dim Stab of M.P. Films 1934; ASA Z22—1935; High Intensity Lamps—1935; Program Spring Convention Apr. 26, 1939. Write John Faber, 5 Edgewater Drive, Denville, N. J. Phone Rockaway 9-2623M.

June 1940 through Jan. 1950. Write Earle F. Orr, 345 Fellsway West, Medford, Mass.

Dec., 1936; Jan., Feb., Apr., May, July, Sept., Nov. 1937; 1938 complete; 1939 complete; 1940 complete; Jan.–Aug. 1941. Write Richard S. Norton, Warner News Inc., 625 Madison Ave., New York 22.

Collection of back issues available either singly or as a lot. Write F. H. Cole, 1258 So. Burnside Ave., Los Angeles 19.

Wanted

All Journals published in 1938 or earlier. Write John P. Byrne, Motion Picture Sensitometrics, Signal Corps Pictorial Center, 41-15 48 St., Long Island City 4, N.Y. Thanks are due Major R. E. Herold, Glendale, Calif., who furnished those for 1954, and M. G. Sinkewitch, Hollywood, who donated a complete set for the years 1939 through 1953.

May, July 1944; Jan., Apr. 1945; Jan., Feb. 1946; Jan., Feb., Apr. 1947; Feb. 1950. Write Kraus Periodicals, Inc., 16 East 46th Street, New York 17.

High-Speed Photography, Volumes 2 and 3. Write William T. Mills, University of North Carolina, Dept. of Agriculture & Engineering, Raleigh, N.C.

Complete set of Transactions. Write John Flory, Eastman Kodak Co., 343 State St., Rochester 4, N. Y.

High-Speed Photography, Volumes 1, 2 and 3. Write Jack Gershon, Armour Research Foundation, Technology Center, Chicago 16.

Transactions Nos. 6 and 9. Write W. W. Hennessy, 503 West 41 St., New York.

Transactions Nos. 1, 5, 6, 7 and 9. Write Lloyd E. Varden, Pavelle Color Inc., 533 West 57 St., New York 19.

High-Speed Photography, Volume 2. Write J. H. Waddell, Fairchild Camera & Instrument Corp., 88-06 Van Wyck Expressway, Jamaica 1, N.Y.

a new approach to film processing

The E.D.L. DM-11 Spray Processor— 48 sec from camera to projector at a rate of 52 ft/min using Du Pont 930 Reversal Pan

This machine was designed and built for the Delaware Steeplechase and Race Association by the E.D.L. film process machine engineers, designers and builders of all types of process machines for the quality-minded film producer and laboratory. We offer services in the design and construction of magnetic recorders, video recorders, special-purpose printers and high-production film process machines for all film processes. We invite a statement of your problems.

the E.D.L. Company

5929 E. Dunes Highway, Gary, Ind.

employment service

These notices are published for the service of the membership and the field. They are inserted three months, at no charge to the member. The Society's address cannot be used for replies.

Positions Wanted

16mm Cameraman familiar with all phases of industrial production wants permanent position. Write Robert M. Jackson, 419 W. Polk, Apt. 4, Houston 19, Texas.

Animator leaving military service desires position with industrial or TV film producer. College degree in motion-picture production. Experience includes animated TV commercials and 2 years with U.S. Air Force in graphic animation. Thorough knowledge of field including layout design, key drawings and in-betweens, and photography on Acme stand. Letters and films on request. Lt. Louis O. Hertz, P.O. Box 462, Valparaiso, Fla.

One-Man Productions. M.A. Communications. Five years experience in every aspect of 16mm productions, color, sound and newsreel. Seeks interesting and challenging assignment here or abroad. Elliott H. Butler, 110 East Grand St., Mount Vernon, N.Y.

Writing-Production Team. Completely and well equipped for 16mm color and sound. Operating own script to answer print studio since 1952. Seeks incorporation into organization or company as production department. Also interested in working exclusively for organization or person requiring extensive location and production work in or out of U.S.A. Complete references, background resumes and production sample on request. Write: Clark and Conkling, Box 1161, Reading, Pa

Positions Available

16mm Processing Technician. Excellent opportunity for top-notch man; must be neat, orderly, accurate and possess knowledge of photographic chemistry. Send resume of background and experience to Eugene F. Fischer, Fischer Photographic Laboratory, Inc., 1731 N. Mobile Ave., Chicago 39, Ill.

Electronic Specialists for basic and applied research on new devices for military use. End items in this field are mine detectors and related equipment resulting from basic and applied research in electronics, electromagnetic field and radiation theory, information theory, statistics and geophysics. Applicants must hold a degree in electrical engineering, physics or mathematics, or have considerable practical research experience in their fields. Salaries range from $4345 to $8940 per year, commensurate with education and experience. Write to: Walter H. Spinks, Acting Executive Officer, Engineer Research and Development Laboratories, Fort Belvoir, Va.

General Engineer, GS-11, salary $6300 per annum. Requirements: A degree in engineering plus two and one-half years of progressive professional experience in electronic and mechanical engineering; *or* six and one-half years successful and progressive experience in technical engineering. Specialized experience in recording processes and recording equipment is desired. Send resume, complete information, to Industrial Relations Dept., Office of Naval Research, Special Devices Center, Port Washington, L.I., N.Y.

Mechanical Design Engineers—Senior Grade. Openings immediately available. Basic knowledge of the professional motion-picture production cycle necessary, with specific emphasis on laboratory functions. A knowledge of 16mm and 35mm printers would be helpful, but is not required. For interview telephone AM 2-1600 or wire to George L. Oakley, c/o Bell & Howell Co., 7100 McCormick Rd., Chicago 45.

Motion Picture and Still Photography. Growing producer in South has excellent opportunity for experienced man. Must also have editing experience. Give resume and references in first letter. Continental Productions Corp., 539 Vine St., Chattanooga, Tenn.

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Meeting Calendar

Acoustical Society of America, Dec. 15–17, Brown U., Providence, R.I.

Mathematical Association of America, Dec. 30, Rice Institute, Houston, Texas.

American Association for the Advancement of Science, Annual Meeting, Dec. 26–31, Atlanta, Ga.

National Symposium on Reliability and Quality Control, sponsored by I.R.E., American Society for Quality Control, and Radio, Electronics, and Television Manufacturers Association, Jan. 9–10, 1956, Hotel Statler, Washington, D. C.

SMPTE Central Section, Jan. 16, 1956; Feb. 20, Mar. 19, Apr. 16, May 21, June 18

American Society for Engineering Education, Jan. 26, 1956, Marquette University, Milwaukee, Wisconsin.

Association of Cinema Laboratories, Jan. 26, 1956, New York.

American Institute of Electrical Engineers, Winter General Meeting, Jan. 30–Feb. 3, 1956, Hotel Statler, New York.

American Institute of Physics, 25th Anniversary Celebration, Jan. 30–Feb. 4, 1956, Hotel New Yorker, New York.

Optical Society of America, Feb. 1, 1956, (Massachusetts Institute of Technology, Cambridge, Mass.)

Acoustical Society of America, Feb. 1, 1956, (57 E. 55 St., New York 22).

Royal Photographic Society of Great Britain, Scientific and Technical Group, Annual Meeting, Mar. 15, 1956, London.

Inter-Society Color Council, Annual Meeting, April 5–6, 1956, Hotel Statler, New York.

Optical Society of America, Apr. 5–7, 1956, Bellevue-Stratford, Philadelphia, Pa.

International Symposium on Nonlinear Circuit Analyses, II; sixth of a series sponsored by the Polytechnic Institute of Brooklyn, Apr. 25–27, 1956, Engineering Societies Building, New York.

79th Semiannual Convention of the SMPTE, including Equipment Exhibit, Apr. 29–May 4, 1956, Hotel Statler, New York.

ASME-Engineering Institute of Canada Joint Meeting, May 23–25, 1956, Mount Royal Hotel, Montreal.

American Society of Mechanical Engineers, Sept. 10–12, 1956, Denver.

Theatre Owners of America, Inc., Annual Convention, Sept. 19–25, 1956, Coliseum, New York.

National Association of Educational Broadcasters, Oct. 1956, Atlanta.

80th Semiannual Convention of the SMPTE, Oct. 7–12, 1956, Ambassador Hotel, Los Angeles.

Optical Society of America, Oct. 18–20, 1956, Lake Placid Club, Essex Co., N.Y.

Optical Society of America, Mar. 7–9, 1957, Hotel Statler, New York.

81st Semiannual Convention of the SMPTE, Apr. 28–May 3, 1957, Shoreham Hotel, Washington, D.C.

82nd Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 6–11, 1957, Hotel Statler, New York.

83rd Semiannual Convention of the SMPTE, April 20–26, 1958, Ambassador Hotel, Los Angeles.

84th Semiannual Convention of the SMPTE, Oct. 19–24, 1958, Sheraton-Cadillac, Detroit.

85th Semiannual Convention of the SMPTE, May 3–8, 1959, Fontainebleu, Miami Beach, Fla.

86th Semiannual Convention of the SMPTE, including Equipment Exhibit, Oct. 5–10, 1959, Hotel Statler, New York.

SMPTE Officers and Committees: The rosters of the Officers of the Society, its Sections, Subsections and Chapters, and of the Committee Chairmen and Members were published in the April Journal.

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